PATENT SPECIFICATION

685,209

Date of filing Complete Specification (under Section 16 of the Patents and Designs Acts, 1907 to 1946) Aug. 16, 1950.

Application Date Aug. 16, 1949. No. 21305/49.

Application Date Feb. 3, 1950. No. 2875/50.

Complete Specification Published Dec. 31, 1952.

Index at acceptance:—Class 38(iv), A2b(2:3).

COMPLETE SPECIFICATION

Improvements in Colour Lighting and Control Apparatus therefor

I, ROLLO GILLESPIE WILLIAMS, a British Subject, of 35, Bellingham Lane, Great Neck, Long Island, New York, N.Y., U.S.A., do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to colour lighting and has amongst its objects to provide new or improved control apparatus therefor.

In carrying the invention into effect there may be a plurality of independent sources of light adapted to emit light of contrasting hue or colour; or there may be a single light source and means associated therewith for obtaining different colours; there may be means whereby a single beam emits different colours or a single light source may be adapted to emit a plurality of beams. The source or sources of light may be coloured or may have associated therewith means such as colour filters for producing the desired colour. The different coloured lights are mixed to produce the desired colour or hue. Means are provided for varying the intensity of light from the sources as desired; the light sources are preferably of any suitable electric type and means are preferably provided for selectively varying the electrical input to the sources to vary the intensity of emitted light but any other suitable means for obtaining this result may be employed. The expression "plurality of light sources" as used herein means and includes (where the context so permits) a single light source having associated with it means for emitting a plurality of different colours, the said means constituting the "plurality of light sources".

The control apparatus according to this invention may have associated with it an indicator scale bearing the names of a range of colour hues and associated with said scale is a manually operable indicator; it is a feature of the invention that as the indicator is moved relatively to the scale the hue or colour indicated by the indicator is automatically obtained from the light sources.

In the alternative the indicator is dispensed with and a predetermined cyclical variation of colour hues is obtained; different cyclic variations may be obtained as desired.

From one aspect the present invention may be said to reside in the provision of control apparatus for a colour lighting system having a plurality of sources of light, two or more light-intensity-varying means, switching means to select each of said plurality of light sources and to connect the selected source to one of said intensity-varying means, a second switching means to connect one of the remaining sources of light to another of said intensity-varying means, operating means common to both of said switching means and said light intensity-varyng means for simultaneous intensity-variation of the light sources selected and connected by said switching. It is to be understood that a light source, as mentioned herein, may consist of a single source of light, as, for example, a single red, blue, or white lamp, or it may include a plurality of sources, all of which are of the same colour. In addition to the two selecting means mentioned above, it is preferred that there shall be additional selecting means for selectively bringing the sources into operation, said additional selecting means having no light intensity variation means associated therewith. In a preferred form of the apparatus all of the selecting means and the variation intensity means are actuated by a common control device so that the light emitted at any position of said device is predetermined; it is also preferred that the indicator associated with the indicator scale

shall be operated directly or indirectly by the same device so that the emitted light corresponds with the light indicated by the indicator on the scale; furthermore, the indicator may be dispensed with and a predetermined cyclical variation of colour hues obtained; also different cyclical variations may be obtained as desired.

Another feature of the invention resides in the provision of means whereby either or both of said selecting means may function to bring selectively into operation individual sources of light or a combination of two or more of said sources; for example, at certain stages of operation of the apparatus either or both selecting means may bring into operation individual sources of light and at other stages may bring into operation two or more of said sources; when one selecting means brings into operation a single source the other means may bring into operation a plurality of said sources.

By the present invention means are provided whereby the light smoothly merges without a break from any selected colour in one range to any selected colour in another range; furthermore, any selected colour may be smoothly dimmed to nil. The invention also provides means whereby a number of selected colours can be obtained at a lighting intensity less than the normal full brightness of the selected colour.

In colour lighting control apparatus heretofore used, it was customary to employ a dimmer, with its associated mechanism, for the control of each light source. An important object of the present invention is to control four sources of light by two dimmers, thereby effecting a substantial decrease in cost and reduction in bulk of the control apparatus.

Another object of the invention is to provide flexibility in selecting groups of colours so as to afford a variety in the range of illumination, as, for example, a deep colour range, or a pastel range, or others.

The above and other features of the invention are set forth in the appended claims and are disclosed in the following detailed description given by way of example of particular embodiments. In the drawings filed with Provisional Specification No. 21305/49:—

Figure 1 is a perspective view illustrating by way of example one type of control apparatus in accordance with this invention;

Figure 2 is an enlarged representation of the colour scale shown in Figure 1;

Figure 3 is an enlarged view of the range control scale and knob shown in Figure 1;

Figure 4 is a vertical sectional view of the apparatus along the line 4—4 of Figure 1 and including switches A—D;

Figure 5 is a horizontal sectional view of the apparatus along the line 5—5 of Figure 4;

Figure 6 is a sectional detail view on the line 6—6 of Figure 5;

Figure 7 is a sectional view on the line 7—7 of Figure 6;

Figure 8 shows the movable arm and the segments mounted upon the insulating plate 81 of switch C;

Figure 9 shows the movable arm and the segments of that portion of the range switch D associated with the red light as shown in Figure 10;

Figure 10 is a circuit diagram showing the electrical connections in one form of embodiment of this invention;

Figure 11 is a chart representing the intensity of the colour or combination of colours for various positions of the brushes associated with the switches of Figure 10; and

Figure 12 indicates the voltages of the dimmers for various positions of the selector switch of Figure 10.

In the drawings accompanying the Provisional Specification No. 2875/50:—

Figures 13 and 15 are circuit diagrams showing the electrical connections of modifications of the invention, in which the cyclical variation on the intensity of light emission of one group of colours is out of phase with that of the other group; and

Figure 14 is a colour chart showing the colours and hues attainable by the arrangements of Figures 13 and 15.

For the sake of convenience in describing the invention, it will be assumed that the colour lighting system in which the present invention is embodied, has four light sources, namely, red, green, blue, and white, as indicated in Figure 10 and that those sources are so arranged and controlled in the present invention that the colours emitted therefrom will either be unmixed or will mix or mingle to produce different hues or shades of colours as desired. As mentioned hereinbefore, each light source may consist in a single light emitting element, such as a lamp, or may include a plurality of such elements all of which provide the same colour of illumination.

The underlying principle of this invention will best be understood from the following description of the circuit shown in Figure 10, which shows schematically one form of embodiment of the invention.

In that circuit 100 and 101 represent the conductors of an alternating current lighting circuit from which are derived the voltages to be applied to the lamps for the production of colour illumination, the neutral or grounded side of that circuit being represented by conductor 101, but it is to be understood that direct current may be employed with suitable resistors for the production of the required voltages. To the A.C. circuit 100—101 are connected two dimmers designated A and B. The form in which those dimmers are represented in Figure 10 is that of an auto-transformer, but it is to be understood that other forms of dimmers, such as, for example (but without limitation), saturable reactors, electronic devices or resistors may be used. The movable contact members of dimmers A and B are electrically connected to brush-arms, such as 40 and 41, respectively, of a selector switch C. The brush-arm 39 is electrically connected directly to the feeder side, that is to say, the non-neutral or non-grounded side of the lighting circuit. The brush attached to the arm 40 is adapted to make contact with a plurality of conductive segments such as 42 to 49, inclusive, of switch C, each of which is connected to a conductive segment of a range switch D; similarly, the brush attached to arm 39 is adapted to make contact with a plurality of conductive segments such as 56 to 60, inclusive, of the switch C, each of which segments is connected to a conductive segment of switch D; and the brush attached to arm 41 is similarly arranged to make contact with segments such as 61 and 62 of switch C, each of which is connected to two contact points and a segment of switch D. The segments of the range switch D to which are connected said segments 42 to 49, inclusive, and also segments 56 to 60, inclusive, of the selector switch C, are in turn connected through the brush-arms 4, 5, and 6 to the red, green, and blue lamps, the particular connections depending upon the position at any instant of the switch D. Segment 61 of switch C is connected by lead 112 to the conductive segment 76 of switch D and is also connected to terminals 73 and 114 of the latter switch. Segment 76 will be connected to the red lamp when the brush of arm 4 makes contact therewith and in like manner the terminals 78 and 114 will be connected through brush-arm 3 to the white lamp. Segment 62 of switch C is connected by lead 113 with segment 85 of switch D which will be connected to the green lamp when the brush of arm 5 makes contact therewith That same lead is also connected to contacts 84 and 115 through which a connection to the white lamp may be established by the brush-arm 3.

The conductive segments 42 to 49, inclusive, of switch C, are preferably arranged as arcs of a circle upon an insulating plate such as 80 shown in Figure 5. Between the adjacent segments is shown a dead stud which is electrically insulated from the segments and other parts of the apparatus but it is to be understood that that stud and others shown upon the drawing and mentioned hereinafter are not essential to the operation of the apparatus. Such studs are numbered (in Fig. 10) 50—55 and 83. The conductive segments 56 to 60, inclusive, are arranged as arcs of two concentric circles upon an insulating plate such as 81 as shown in Figure 8, the segments being of such length and so positioned that the brush will make simultaneous contact with two consecutive segments at positions 2, 4, 6 and 8 of the switch (see Figure 10). The segments 61 and 62 are mounted upon an insulating plate such as 82 in Figure 5, and arranged preferably as arcs of the same circle with a dead stud positioned between the segments. The brush-arms 40, 39 and 41 are preferably mounted upon the same shaft, 19, and are so aligned that the brushes of all of said arms will make contact with their respective first segments at the substantially same instant.

The brush-arms 3, 4, 5, and 6 of switch D are preferably mounted upon the same shaft, 2, as shown in Figure 5, and are in alignment so that at each operative position of the switch (except the "off" position) contact will be made between the segments at such operative position and the corresponding brushes of the switch. The conductive segments of the range switch D are mounted upon insulating plates, such as 116 to 119, inclusive, shown in Figure 5. Those segments are arcuate in form as shown in Figure 9 which represents the arrangement of the segments 65 to 68, inclusive, and 76 to 78 inclusive, with which brush 4 is designed to make contact at the positions indicated in Figure 10. The segments and the contact point with which the brushes of the other arms of switch D are arranged to make contact would be so positioned upon their respective insulating plates as to enable the brushes to make contact therewith at the several operative positions of the switch as indicated in Figure 10. Thus each segment of the group 65 to 68, inclusive, of switch D is connected electrically to a segment of switch C as shown in Figure 10; segments 66 and 68 are also connected to segments 77 and 78, respectively, of switch D, and

segment 76, as mentioned before, is connected to lead 112. The brush on arm 4 is arranged to make contact simultaneously with all segments in the group 65 to 68, inclusive, or the group 76 to 78, inclusive, so that all segments of each group will be connected through the arm 4 and the ring 79 (Figure 9) to the red lamp shown in that circuit. Similarly, contacts of the groups 69 to 72, inclusive, and 85 to 87, inclusive, are arranged upon the insulating plate 118 and connected through brush-arm 5 with the green lamp of that circuit. Segments 74 and 75 are, in like manner, arranged upon plate 119 for connection through the brush-arm 6 with the blue lamp; and contacts 73, 84, 114 and 115 are also mounted upon insulating plate 116 for connection through the brush-arm 3 with the white lamp. The range switch is designed to be moved at will by the operator and is mechanically independent of the remainder of the control mechanism.

As will be described more fully hereinafter, the contact member of dimmer A is mechanically controlled by a knob, such as 14 (Figure 1), which is the same member that controls the movement of the brush-arm 40 of switch C, so that there is a definite relationship between the instantaneous voltages produced by dimmer A and the position of the brush-arm 40 during the course of its passage over the segments 42 to 49, inclusive, the relationship being shown by the upper graph, 120, of Figure 12. The contact member of dimmer B is also controlled by the same member that controls the brush-arm 41, viz., the knob 14, and, in consequence, there is likewise a definite relationship between the voltage produced by dimmer B and the position of brush-arm 41 during its passage over the segments 61 and 62, the voltage relationship being shown by the lower graph, 121, of Figure 12. From those graphs it will be seen that while the voltage on dimmer B passes through one cycle, that of dimmer A passes through four complete cycles. It is to be understood that the number of cycles mentioned is purely by the way of illustration and is not to be construed as a limitation upon the invention. The means for maintaining the aforedescribed relationship between dimmer voltages and positions of the brush-arms, and the purpose in maintaining the voltage relationships between the two dimmers will be fully described hereinafter.

The manner in which the aforedescribed apparatus operates to effect the production of a range of hues of colours will now be described. Assuming, for example, that the switch D is set at the "Deep Colour" position, the brushes of arms 4, 5 and 6 of that switch will then connect the sources of red, green and blue light, respectively, to the groups of segments of switch D with which those brushes are then in contact. Let it be further assumed that the knob 14 is turned so that the brushes of the arms 40, 39 and 41 are in contact with segments 42, 56 and 61, respectively, at position 1 of switch C, as shown in Figure 10. Thereafter the voltages applied by selector switch C to the segments of switch D at the "Deep Colour" position are, in turn, applied to two of said sources of light. Thus, the voltage from dimmer A, when brush 40 is at position 1 of switch C, is applied to the red source but since at that instant the voltage is zero, as shown in Figure 12, no light will emanate from that source. The voltage, which is applied by brush 39 to segment 56 at position 1 of switch C, is, in turn, applied to the source of green light and since that is the full line voltage, illumination of full intensity will come from that source. The voltage from dimmer B produces no effect in the "Deep Colour" range since the brush of switch D, viz. 73, to which the voltage of dimmer B is applied, is not in contact with any segment of switch D at the "Deep Colour" position. Accordingly, for position 1 of the selector switch C, no red or blue colour will be present in the illumination, only green, and that result is shown clearly in Figure 11, in the graph designated "Deep Colour Range".

Referring again to Figure 12, it will be seen that as the brush 40 of the selector switch C is moved over the segment 42 between the points 1 and 2, the voltage produced by dimmer A rises. When the brush 40 reaches a position which is just to the left of point 2 (as shown in Figure 10), the voltage applied to the source of red light will be nearing the maximum voltage of the line circuit as shown in Figure 12. At that instant brush 39 is in contact with segment 56 which is connected with the source of green light and applies thereto the full line-voltage, thus causing green illumination at full intensity. The resultant hue will be the combination of red and green as shown in Figure 11 just to the left of position 2. When brush of brush-arm 40 is about to break contact with segment 42, the brush of arm 39 will make contact with segments 56 and 57 simultaneously, the former of which is connected to the source of green light, the latter to the source of red light, both receiving the full line-voltage. The red source will also be receiving maximum voltage from dimmer A

so that there is no break in continuity of illumination from the red source when the brush of arm 40 passes from segment 42 to segment 43. Upon the passing of the brush 40 onto segment 43 the voltage of dimmer A will be applied to the green source. Referring to the graph 120 of Figure 11, it will be observed that the voltage from dimmer A steadily diminishes in value during the course of travel of the brush 40 over segment 43 from left to right. Throughout this same period the full line-voltage is applied by brush 39 to the red source and consequently the illumination will be a combination of green and red, the green colour gradually diminishing and vanishing when the brush 40 moves out of engagement with segment 43, the illumination thereafter coming entirely from the source of red light. When the brush 40 moves onto segment 44, the dimmer A will be connected by the lead 104, segment 74, and brush 6 of switch D to the source of blue light. As shown in Figure 12, the voltage from dimmer A rises from O to its maximum as the brush 40 moves over segment 44, and when it reaches the end of that segment, the colour and intensity of illumination will be the result of the full illumination of the sources of red and the blue light.

From the foregoing description it will be obvious that as the brush of arm 40 is moved across the remaining segments 45 to 49, inclusive, and at the same time the brush of arm 39 is moved across segments 58 to 60, inclusive, the voltage from the dimmer A and that directly from the line will be applied to a selected pair of sources of coloured light producing an illumination having the deep colours, red, green and blue or combinations thereof, the resultant colour of illumination depending not only on the colours selected but also upon the voltages applied to the lamps at each instant as shown in the "Deep Colour Range" graph of Figure 12.

If the segments of selector switch C were permanently connected to certain sources of coloured light, such as red, green and blue, to which they are now connected through the segments and brushes of switch D for the "Deep Colour" setting of that switch, the range of illumination variation that the control system is capable of producing would obviously be greatly limited. To avoid such limitation the leads from the segments of selector switch C are not permanently connected to the sources of light but to the segments of the range switch D, and, in consequence, it is possible to obtain many ranges of colours that otherwise would be lost. For example, if the range switch D is set at the "Pastel Colour" position the shades or hues resulting therefrom will be those indicated along the upper edge of the chart 38, Figure 2, which represent the combination of the deep colours, red, green, and blue with white. Those shades or hues range from "warm white" at position 120° on the chart 38 to "Cold White" at position 0° thereon. If the knob 14 is set so that the indicator needle is at 120° on the chart, which corresponds with position 1 of the selector switch C, the voltage of dimmer A will be applied to the red source, that of dimmer B to the white source and the full line voltage will be applied through brush-arm 39 to the green source. At that instant the voltage of dimmer A is zero, as shown in Figure 12, and that of dimmer B is the maximum. The resultant illumination is the combination of green and white at full voltage, the sources of red and blue light providing no illumination, as indicated by the "Pastel Colour" graph of Figure 11.

If knob 14 is now rotated so that the indicator needle is moved to position 110 on the colour scale, the brush-arms 41, 39 and 40 will have reached a position which is just short of position 2 in Figure 10 and the dimmers A and B will be correspondingly positioned. At this point the red lighting circuit connected to dimmer A will be nearing full-voltage, as shown in Figure 12; the green lighting circuit connected brush 39 will continue at full strength, and the white lighting circuit connected to brush 41 will be at a somewhat reduced lighting intensity as shown by graph 121 of Figure 12.

If the indicator needle 37 is again moved to position 105 on the scale, the brushes 41, 39 and 40 will be as shown at position 2 in Figure 10 and the dimmer voltages will be as shown in Figure 12. At this position the brush of arm 40 is in contact with a dead stud such as 50 so that the red lighting circuit is no longer connected to dimmer A. However, the brush of arm 39 is now in contact with both segments 56 and 57, the former being connected to the green lamp and the latter connected through contact 67 of switch D to the red lamp as mentioned hereinbefore in describing the "Deep Colour" method. Both red and green circuits are, therefore, directly connected to the mains by means of brush-arm 39 and therefore receive full voltage. The white lighting source remains connected to dimmer B but at a lower lighting intensity since the voltage is dropping. The hue resulting is that comprising red and green illumination at full intensity and white of dimin-

ishing intensity. As mentioned hereinbefore, when the brush of arm 40 is about to move out of contact with segment 42 and into contact with dead stud 50, the dimmer A is providing full-voltage, as shown in Figure 12, and the brush-arm 39, while still in contact with segment 56, makes contact also with segment 57. Segment 57 is connected by conductor 108 to the red lamp while segment 42 is also connected thereto which effects the transfer of the red circuit at full-voltage from dimmer A to full voltage direct from the lighting circuit through segment 57. There will be no visible change in the brightness of the red lighting circuit to the eye if segment 57 is contacted by brush 39 before brush 40 breaks contact with segment 42. At position 2 in Figure 10, we therefore have the red and green lighting circuits at full brightness and the white lighting circuit at a reduced brightness, producing a pale yellow shade as indicated on chart 38, Figure 2.

If knob 14 continues to be turned until the indicator needle 37 is at position 90 on the scale 38, then the brushes of the arms will be at position 3 in Figure 10 and the dimmer voltages will be as shown in Figure 12 for that position. At this point the voltage from dimmer A is at its minimum and brush-arm 40 is on dead stud 51, having broken contact with segment 43 at the bottom of the voltage cycle. The resultant shade or hue will be that produced by the red lamp at full voltage and the white lamp at about one-half its maximum voltage.

The process of selecting the sources of illumination of the desired colours for the production of the pastel shades continues in the manner first described as the brushes of the selector switch C are moved from one position to the next over the remaining segments of that switch until the entire range of shades of colour indicated on Chart 38, along its upper edge, has been produced.

In addition to the production of pastel colours and the deep colours, as described hereinbefore, other colour ranges or effects are made possible through the proper adjustment of the range switch D. Thus, for example, when the brushes of the switch D set at the " Dim " position, the illumination comes solely from the blue source, the intensity of which depends upon the voltages applied by the brushes 40 and 39 to the segments of the selector switch C. If the brushes of switch D are moved to the " Low Intensity " position, the illumination results solely from the sources of red, green and blue light or combinations thereof (as in the " Deep Colour " position), but, as shown in Figure 11, the voltages applied to the lamps at the " Low Intensity " position differ from those at the " Deep Colour " position of the switch D with the result that the illuminating effects differ markedly in the two cases. At the low intensity dim position, designated " L.I. Dim ", blue is omitted, only red and green being employed, and at the last position of switch D, the illumination results solely from the sources of white light, as indicated.

The method of operating the apparatus hereinbefore described assumes the setting of the range switch D at a particular position, such as the " Deep Colour " or " Pastel Colour " position and operating the selector switch C throughout its range to effect the production of coloured illumination that varies with selection of colour and applied voltage. But the use of the control system is not limited to that method. There are other modes of operation that afford equally desirable results; for example, assume that it is desired to know the range of coloured illumination that is obtainable at a particular position, say 97.5 on the scale 38 of the apparatus. If the knob 14 of the selector switch C is turned so that the indicator pointer 37 is placed at that position on the scale, the light sources that are effective at that point and the voltages applied thereto either by the dimmers or directly by the lighting circuit 100—101 will be those indicated at the position of the vertical dotted line X1—X2 in Figure 11 for the various positions of the range switch. If the range switch is then turned to each of its seven positions, the resultant colour hue provided by the lighting circuits will be as follows:—

Range Switch	Final Colour of Light (At position 97.5 of scale 38)
Off	No light
Dim	No light
Deep colour range	Orange
Pastel colour range	Gold
Low intensity range	Dull yellow
Low intensity dim	Dull yellow
White only	Low brightness white

The manner in which the selector switch C, the range switch D, and the dimmers A and B may be arranged and controlled mechanically is shown in Figures 4 and 5 which illustrate one form of embodiment of the invention. As shown in Figure 5, the knob 14 is mounted upon a shaft 15 to which is fastened at the end nearer the knob, a pinion 16 (shown in Figure 4) and at the far end of the shaft, a crank wheel 17, said shaft being mounted upon a suitable base 122. The pinion 16 engages with a larger gear-wheel 18, mounted on shaft 19 which is the actuating shaft of the rotary selector switch C, said shaft being supported by the members 123. Gear-wheel 18 has a crank-pin 20 mounted on its outer face to which one end of the arm 21 is rotatably attached. The arm 21 is effectively connected to the controller wheel 22 of dimmer B by which the position of the movable contactor upon the winding of the dimmer may be changed or altered, at will. In the construction shown, by way of example, the means for changing the position of said contactor is illustrated in Figures 6 and 7 from which it will be seen that the arm 21 rests in a groove on the perimeter of wheel 22 and is fastened to said wheel by means of a wire cable, 23, secured at 24 and passed round the outside of wheel 22 (to which it is secured at point 25), and then finally secured again to arm 21 at point 26. It will, of course, be understood that a chain or a rack and pinion may be substituted for the cable shown. Accordingly, when the arm 21 is pulled and pushed as the result of the rotation of the gear-wheel 18, it will impart a rotary motion to the wheel 22, which motion is transmitted to the shaft 27 to which the movable contactor of dimmer B is fastened.

The movement of the contactor of dimmer A is effected in similar manner by means of arm 28, one end of which is connected to the crank-pin 30 of the crank-wheel 17, and the other end of said arm is connected to the wheel 29 by a wire cable so as to impart rotary motion to the shaft 31 of dimmer A and to the movable contactor thereof.

It will be noticed that the rotary motion imparted to each dimmer is reciprocating in character inasmuch as one revolution of a crank-pin, such as 30, around the axis of a crank-wheel, such as 17, will cause dimmer shaft 31 of dimmer A to be rotated first in one direction and then in the other. In practice, the exact amount of movement imparted to the dimmers may be adjusted by mounting the crank-pin in a radial slot upon the crank-wheel and determining the effective distance of the crank-pin from the centre of the crank-wheel to give the desired angular movement of the dimmer shaft. If this radius is shortened, the angular distance clockwise and counter-clockwise, through which the dimmer shaft moves will be also shortened, and *vice versa*. Both dimmers, A and B, are, in the example shown, of a type having rotary action with a total movement of 320°. At 0°, each dimmer provides full light, and at 320° the light is, to all practical purposes, out.

From the foregoing it will be seen that when knob 14 is turned, the resulting rotation of pinion 16, acting through the gear-wheel 18, imparts motion to the shaft 19 of selector switch C and at the same time imparts motion to dimmer B by means of arm 21. Similarly, motion will be imparted at the same time to dimmer A by means of arm 28, connected to crank-wheel 17, at the other end of shaft 15. By means of a pulley, not shown, but which would be fastened to shaft 15, the movement of the shaft will be transmitted to the cable 32 so as to cause it to move in conjunction therewith. The cable 32 passes over the guide pulleys 33, 34, 35 and 36, and between the pulleys 34 and 35 there is attached to the cable an indicator needle 37 which moves over a colour scale 38. From the foregoing it will be clear that the movement of knob 14 simultaneously imparts motion to the indicator needle 37, dimmer A, dimmer B, and rotary selector switch C, and that there is a definite relationship between the position of the needle and that of the contact members of the dimmers and the position of the brush-arms of switch C.

In the example under consideration, the gear ratio of gears 18 and 16 is 4 to 1, and consequently dimmer A which is actuated from a crank-wheel 17 mounted directly on shaft 15, will operate four times as often as dimmer B. This is shown by the graphs 120 and 121 of Figure 12 which represent the voltage variation of the dimmers A and B, respectively, for four complete revolutions of the shaft 15. Each complete revolution of shaft 15 causes the shaft of dimmer A to rotate through the total angular distance of 320°. Since the dimmer B is controlled by the movement of the gear 18, which revolves but once during four revolutions of the crank wheel 17, the shaft of dimmer B will be rotated first in one direction and then in the other direction through the total angular distance of 320° only once during the time in which the shaft of dimmer A is moving four times through the same angular distance. Accordingly, the voltage applied to the circuit by dimmer B, which is shown by the lower curve 121 of Figure 12, will pass

through one cycle during the time in which the voltage produced by dimmer B (as shown by graph 120) passes through four cycles. The variation of the voltage of dimmer B through four cycles and that of dimmer A through one cycle is effected by turning the knob 14 the necessary number of turns; during which period of time the indicator needle 37 will move across the full extent of the indicator scale 38, shown in Figures 1 and 2.

In order to show more clearly the arrangement of the apparatus in the casing in which it is mounted and the mechanical connection between various parts, the electrical connections of the control circuit have been omitted in Figures 4 and 5, but it is to be understood that the apparatus shown in those figures is electrically connected in the manner shown in Figure 10.

From the foregoing description it will be seen that the desired range of colours and hues are obtained in the present invention by the employment of only two dimmers whereas in known colour lighting control apparatus one dimmer with associated mechanism is required for each light source; hence by the present invention costs are reduced and bulk decreased. Furthermore, in some known types of apparatus it is customary first to actuate a member to select a desired colour or hue and then to actuate another member to produce that colour or hue; by the present invention, the desired colour or hue in any predetermined range of colours is immediately obtained merely by moving the selector switch to the desired location.

A particular feature of the invention is the layout of the colour scale as illustrated in the drawings. It will be appreciated that the provision of a plurality of scales of different "types" or ranges of colour is of considerable advantage; any of the ranges can be selected at will and it is possible by the invention to merge from any colour in one range to any colour in another range without a break in the lighting. It will be seen that all the ranges of colours or hues terminate in the same colour (preferably but not necessarily blue) at the same point in the scale, viz. point 60. The method of merging from one colour in one range to a colour in another range consists in bringing the indicator needle 37 to point 60, then turning the range switch D to the position for the desired new range and then moving the indicator 37 to the desired colour shown in that range. Any colour can be dimmed out by first moving the indicator from the colour in question to point 60, then moving the range switch to "Dim" position and then moving the indicator to either end of the diamond in the centre of the scale; at each end the blue light is reduced to no light. When one wishes to start with no light at all and then brighten up into some colour, one commences by placing the indicator needle at either point of the diamond-shape — with the range switch at "Dim"—then moving the indicator needle to blue at position 60, then moving the range switch to the desired position, afterwards moving the indicator needle to the required colour. In order to provide a complete range of low brightness colours the range switch is operated as required between "Low Intensity Range" and "Low Intensity Dim".

The arrangement of colours and hues on the lower scale in Figure 2 is also designed to enable an operator to get from one colour or hue to any other hue by a fairly direct route and without the need of having to pass round a complete colour circle in order to get the change. Inasmuch as this new controller is not a pre-set machine and the lighting actually changes when the needle is moved by the knob 14, one will have to pass through the colours shown as coming between any two selected hues. However, this colour scale is designed in such a manner that in most cases one passes in a fairly direct manner from colour to colour. Obviously, a circular scale may be employed, instead of the rectangular scale shown in Figures 1 and 2, the pointer of which may be directly or indirectly controlled by the shaft 15 which is rotated by the knob 14.

The mechanism as shown in Figures 6 and 7 for imparting a reciprocal motion to a dimmer, is an improvement of the usual "Sine" movement. It will be seen that the crank-arm 21 not only thrusts or pulls, but also changes its angle of contact with the top of wheel 22 in the course of its motion. This double movement tends to change the flat portions of the "Sine" curve and gives more useful movement to the dimmer when the crank pin is around 3 o'clock and 9 o'clock.

If the apparatus is connected to a direct current source of electricity the auto-transformer dimmers referred to herein would obviously be replaced by dimmer resistors or other suitable brightness control and the wiring circuit would be slightly altered, the manner of doing which will be obvious to anyone skilled in the art.

Figures 13 and 15 disclose in diagrammatic form embodiments of the invention having means whereby the desired colour or hue can be obtained by actuation of a control member in either of two opposite directions at will, and also having im-

proved means for automatic operation of the control mechanism.

The invention, as embodied in Figures 13 and 15, also consists in the provision of colour control apparatus in which the light from two brightness control systems are combined in combination with means for cyclically varying the intensity of the light emitted from the two systems, the cyclical variation of the one system being out of phase with that of the other system. It is preferred that at least one system shall comprise a plurality of light sources of different colours or hues in combination with means whereby coincident with the cyclical variation of intensity of light emitted from that system the hue or colour of the emitted light shall change in accordance with a predetermined sequence. That is to say, at each phase of rotation of the control apparatus both the colour or hue and intensity of emitted light are predetermined.

In a preferred arrangement the one system comprises a series of differently coloured lights and the other system comprises a source of non-coloured (white) light. Means may be provided for varying the amount of light emitted from one or both systems during each cyclic variation.

For manual operation of the control member there is preferably provided a colour chart and the control member is associated with a pointer or the like which is movable relatively to the chart to indicate emission of that particular hue or colour indicated on the chart. In a preferred method of carrying into effect the invention shown in Figures 13 and 15 a unitary control member is provided which is mounted for rotation through 360° in both clockwise and counter-clockwise directions at will to vary cyclically the intensity of light emitted from the two systems, and the said pointer moves in unison with said control member; it will thus be appreciated that by this means the required hue or colour to be emitted can be obtained by rotating the control either in a clockwise or a counter-clockwise direction. If, for example, a red light is being emitted and it is desired then to emit a blue light the control member can be moved from the red to the blue position either in a clockwise or counter-clockwise direction and by this means the control member can be moved through whichever is the shorter of the two arcs of movement to obtain the desired change.

In addition to the two systems mentioned hereinbefore, there may of course be provided other systems (the light of which mingles with the light of the first two systems) and means for cyclically varying the intensity of light from the additional systems may be provided.

Control apparatus in accordance with the invention shown in Figures 13 and 15 can be designed for automatic operation in which case the control member is preferably rotated continuously as by an electric motor and it may be rotated continuously in the same direction or the direction of rotation may be changed at intervals as desired. Furthermore, means may be provided whereby the speed of rotation may be varied or the rotation may be intermittent with the result that any desired colour or hue may be transmitted for predetermined intervals of time.

A feature of the invention resides in the fact that the cyclical variation of intensity of emitted light from at least one brightness control system is not sinusoidal but is flat topped, but it is desired to state that such flattening of the sinusoidal curve is not essential to the working of the invention, but is preferred.

In the embodiment illustrated in Figures 13 and 15 there are two dimmers, such as A and Z, and associated with dimmer A is a light transmission system incorporating a source of red light R, a source of green light G, and a source of blue light B, and associated with dimmer Z is a light transmission system consisting solely of a source of white light W. It will be appreciated that any suitable source of white and coloured light may be utilized and the transmitted light from all the sources is blended or mingled to give the desired colour or hue.

In the particular embodiment illustrated in Figures 13 and 15 auto-transformers are employed but, as mentioned hereinbefore, dimmers of any suitable type, such as reactors, electronic devices or resistance dimmers may of course be used if desired.

The voltage applied to the two light systems is cyclically varied by any convenient means and if desired the means disclosed in Figures 4 and 5 and described hereinbefore may be employed. The contact members 130 and 131 of the dimmers A and Z, respectively, would preferably be moved by arms such as 28 and 21 shown in Figures 4 and 5, but to obtain the same rate of voltage variation for dimmers A and Z, the arms would have to be moved at the same rate. This could be done by connecting both arms to the same crank-pin, as 30, or by connecting the arm 21 to another crank driven by another pinion, such as 15 meshed with gear 18. The arms for operating the dimmers A and Z are indicated by the dot-and-dash lines connected to the shaft 137 in Figures 13 and 15. The cyclical variation

of the voltage from dimmer A is represented by the sinusoidal curve C1, the top of which has been flattened, and that from dimmer Z, by the curves C2 and C3 which are out of phase with C1, the phasing being controlled by adjustment of the dimmers. These curves merely indicate the type of voltage variation and are not necessarily accurate; it will be appreciated that the variation of emitted light from the light transmitting systems is related to that of the applied voltage. As mentioned, the curve C1 is flat topped, that is to say, during approximately 20% of each cycle in the example shown, the maximum voltage is maintained without variation but it is to be understood that the percentage may be varied as desired. This flat-topped curve is achieved by making the dimmer contact brush associated with dimmer A, move over a contact plate (indicated by 141) at full potential during, say, a few degrees, of its upward travel. The winding of dimmer Z is tapped at a point such as 132, to provide a source of current of lower voltage, as represented by the curve C3, for application to the white lamp.

Associated with the three sources of coloured light comprising the first light transmitting system are a series of conductive segments, D1, D2, D3, D4, D5, D6, D7, D8, D9 and D10. These are conveniently mounted in the form of arcs on suitable discs or plates of insulating material and brushes for wiping them are provided as indicated at E1 and E2. Conveniently, there are two brushes, and brush E1 wipes segments D1—D6, inclusive, and brush E2 wipes segments D7—D10, inclusive. These brushes are mounted on a shaft, indicated by the dot-and-dash line 137, which can be manually rotated clockwise or counter-clockwise, as desired, and a pointer P (Figure 14), connected directly or indirectly with the shaft 137, rotates in unison with the brushes E1 and E2.

The construction of these discs, segments, and brushes, would, in principle, be substantially as illustrated in Figures 8 and 9, differing structurally in the number of segments and their positioning upon the insulating discs. For convenience, the segments are depicted in Figures 13 and 15 in the form of a linear projection the colour changes being effected by moving the brushes (theoretically) linearly relative to the segments.

If the brushes E1 and E2 are so moved to the several positions 1, 2, 3, etc., the different sources of coloured light and combinations thereof, from which light will be emitted as a result of such movement, are represented by the letters R, G, B, associated with the curve C1.

Associated with dimmer Z in Figure 13, is a switch S having two contacts, S1 and S2. When switch S is moved to contact S1, the applied voltage varies cyclically between maximum and minimum and the intensity of the emitted white light varies similarly as is indicated by curve C2, but when the switch S is moved to contact S2, the maximum applied voltage is reduced and the cyclical variation of the applied voltage and the intensity of the emitted white light is represented by curve C3.

From the foregoing it will be apparent that the white light controlled by dimmer Z commences to have a marked effect in the colour mixture during the period that the colour lighting controlled by dimmer A and associated mechanism is remaining constant, that is, during the flat topped phase. At the point when the white light is reaching its peak and is about to diminish, the light controlled by dimmer A also commences to reduce the intensity of transmitted light from the colour system of the red, green and blue colours, and it will be obvious from a consideration of the diagrammatic curves that there will be a constantly changing mixture of light the results of which are very effective.

Each dimmer preferably completes three full cyclical variations as indicated by the curves C1, C2, and C3, when the brushes of the segmental switches have rotated through 360°, but obviously, any desired number of cyclical variations may be employed.

Referring now to Figure 14, it will be seen that there is an inner and an outer scale of light, and as the pointer moves clockwise or counter-clockwise the hues or colours indicated on the outer scale are obtained when switch S closes the contact S2, and the inner scale of light is obtained when the switch closes the contact S1. As the pointer is moved around the scale, the colour or hue of illumination changes as indicated. For example, if the pointer is in the location indicated upon the chart, Figure 14 and switch S is in contact with contact S2, red light will be transmitted. If now it is desired to transmit a hue such as magenta, the pointer is moved in counter-clockwise direction, but if it is desired to transmit a hue such as amber, then obviously the pointer would be moved in a clockwise direction. It will thus be seen that by the present invention the operator need not move the controller through the whole range of colours to effect the desired colour change.

When the switch S closes contact S2, the value of white light is considerably reduced. When contact S1 is closed, the "flesh whites", the "warm whites",

and "cold whites", indicated on the inner scale, can be obtained by rotation of the pointer to the positions indicated on the chart. It is desired to point out that in the regions between the zones "warm whites," "flesh whites", and "cold whites", the colours of the resulting illumination will be those shown in the outer circle.

The pointer in the position shown in Figure 14 corresponds to the position of brushes E1, E2, making contact with the two left-hand ends of contacts D1 and D7 of the selector switch.

For the purpose of explanation, it will be assumed that when the pointer is moved in a clockwise direction the brushes move in the diagrammatic drawing of Figure 13 linearly from left to right and produce the complete colour change shown in the outer sketch of Figure 14.

It will be readily appreciated that the apparatus in accordance with this invention can be used for automatic colour mixing such as by rotating the operative parts from an electric motor or other convenient source of power. The motor which is represented diagrammatically by 140 is connected by any suitable means, directly or indirectly, with the shaft 137, and may rotate continuously in the same direction at a constant speed or the speed may be varied and/or the motor may at intervals be reversed thereby giving variety to the colour effects produced by the apparatus. If it is desired to transmit selected colours for predetermined intervals of time the motor may be intermittently rotated; for example, a ratchet and pawl mechanism, or any convenient form of notching mechanism, may be employed, or some of the teeth on the pinion of a driving member, such as 16 of Figure 4, may be omitted. Consequently, although the motor may rotate continuously, the operative mechanism of the control apparatus is rotated intermittently so that at intervals any desired hue or colour may be emitted for any predetermined length of time. Means for disengaging and re-engaging the motor at will may be employed, and there may be a clutch between the control apparatus and the motor which may be engaged and disengaged by automatic means at predetermined intervals of time so that desired colours will be emitted during such periods. While in Figures 13 and 15 of the drawing, a motor drive is indicated, it is to be understood that the rotation of the shaft 137 may be effected by the use of a knob such as 14 of Figure 5.

For automatic variation the switch S of Figure 13 may be replaced by switches SS1, SS2, SS3, as shown in Figure 15, which indicates a suitable wiring for the automatic operation of control apparatus in accordance with the invention. The switches SS1, SS2, and SS3, are double-throw switches, the movable contacts of which are connected to segments D11, D12, and D13, respectively, with which the brush E3 is arranged to make contact as it is moved across those segments simultaneously with the movement of brushes E1 and E2, said brushes being fastened to the shaft 137. Accordingly, at three different points in the cycle of white lighting it is possible to apply to the white lamp either the full voltage of the dimmer Z, as shown by curve C2 of Figure 13, or a lower voltage as shown by curve C3 of that figure. Thus, if double-throw switch SS1 is in the up position on the drawing, the dimmer will feed the white lighting circuit with its proportion of the full voltage during the period in which the brush arm is in contact with the associated segment D13. When the same switch is in the down position, the white circuit will be supplied at a lower basic voltage during the same period of the dimmer cycle. Obviously, all of the said switches may be in their upper position at any instant, or all in their lower position, or one or more may be up, and the remainder down, the selection depending upon the colour effect desired to be produced. The switches may be operated manually or automatically, as, for example, by cams which may be preset to effect the operation of the several switches in any given direction, viz., up or down, and to maintain the switches in the desired position throughout any desired period of time.

Referring again to Figure 14, reference is again made to the three areas on the inner scale which indicate "warm white", "cold white", and "flesh white". When the three double-throw switches, SS1, SS2, and SS3, are in the up position, the maximum voltage of dimmer Z will produce full illumination of the white lamp, and, consequently, at said areas of the dial, the light provided will be a white light, of the nature indicated. When these double-throw switches are in the down position, then the lower value of white illumination resulting from the lower basic voltage will cause the colour mixtures given to correspond to the range of colour hues named in the outer circle.

It is to be understood that in carrying into effect the invention herein disclosed, there may be a plurality of independent sources of light adapted to emit light of contrasting hue or colour, or there may be a single light source and means asso-

ciated therewith for obtaining different colours. Furthermore, there may be means whereby a single beam emits different colours or a single light source may be adapted to emit a plurality of beams. The source or sources of light may be coloured, or may have associated therewith means such as colour filters for producing the desired colour. While the light sources may be of any type, they are preferably of any suitable input to the sources to vary the intensity of emitted light, but any other suitable means for obtaining this result may be employed. The expression, "plurality of light sources", as used herein, means and includes (where the context so permits), a single light source having associated with it means for emitting a plurality of different colours, the said means constituting the "plurality of light sources".

While this invention has been disclosed as embodied in a particular form and arrangement of the parts thereof, it is to be understood that it is not so limited, but that it is capable of embodiment in other forms and arrangements without departing from the spirit and the scope of the appended claims.

What I claim is:—

1. In a control system for colour lighting, in combination, a plurality of sources of light, two or more light-intensity-varying means, switching means to select each of said plurality of light sources and to connect the selected source to one of said intensity-varying means, a second switch means to connect one of the remaining sources of light to another of said intensity-varying means, operating means common to both of said switching means and said light intensity-varying means for simultaneous intensity-variation of the light sources selected and connected by said switching means.

2. The combination defined by claim 1 further characterised in that each of said sources of light, except one, provides a hue of colour, said exception providing a much paler hue.

3. The combination defined by claim 1 or 2 further characterised in that the rates of variation effected by said light intensity-varying means differ from each other.

4. The combination defined by claim 1, 2 or 3 wherein said operating means varies said switching means simultaneously at given intervals, and varies said intensity-varying means continuously throughout said intervals.

5. The combination claimed in any preceding claim, having four sources of light and two light intensity-varying means, the first switching means selecting each of three of said light sources and connecting the selected source to one of said intensity-varying means, and the second switching means connecting the other intensity-varying means to one of the remaining sources of light the light from the selected sources being blended.

6. The combination defined by claim 5 further characterised by the addition of means to indicate the hue resulting from the blending of the light from the selected sources.

7. The combination defined by any preceding claim further characterised in that the sources of light are electrical sources and the light intensity-varying means are voltage varying devices.

8. The combination defined by claim 5, or 6, wherein said second switching means maintains the light of its selected source at an intensity equal to the maximum value of the given range of values determined by said intensity-varying means, first and second switching means being arranged to interchange the said sources when the intensity of light produced by said first-mentioned intensity-varying means reaches its maximum, and wherein a third switching means selects a third source of light and connects thereto the other of said light intensity-varying means.

9. The combination according to claim 5, wherein the light intensity-varying means are adapted to vary the light intensity of the light sources throughout a give range of values of intensity, and wherein said second switching means maintains the light of the source selected by it at an intensity equal to a fixed value of the given range, said first and second switching means being arranged to effect an interchange of the said light sources to which the switching means are connected when the first mentioned intensity-varying means reaches the said fixed value of intensity, a third switching means to select a third source and to connect it to the other of said light intensity-varying means, operating means common to all of said switching means and also to said light intensity-varying means to operate simultaneously all said means, and indicating means controlled by said operating means to indicate the hue resulting from the blending of light from the selected sources.

10. A control system for colour lighting according to claim 1, having four electrical sources of light of different colours, and two voltage-varying devices, wherein a first switching means applies to its selected light source the voltage of one of said devices, and a second switching

means applies to its selected light source constant voltage which equals the maximum voltage of the said first device, said first and second switching means being so arranged that at the maximum voltage of the first mentioned device the connections between said switching means and the selected sources will be effectively interchanged whereby the constant voltage will be applied to the first selected source and the voltage from the first mentioned voltage-varying device will be applied to the second selected source, and wherein a third switching means selects a third light source and connects thereto the other of said light intensity-varying means, the light from the several sources being blended, and there being operating means common to all of said means and to said voltage-varying devices to operate said means and said devices simultaneously, and with indicating means controlled by said operating means to indicate the hue resulting from the blending of light from the selected sources.

11. A control system for colour lighting according to claim 10, wherein each said switching means selects each of said sources of light in sequence, wherein the voltage applied by the first of said devices may be varied throughout a given range of values, the constant voltage applied by the second of said devices being within the range of voltage of the said first device, and the said interchange being effected when the voltage of the first mentioned device equals the said constant voltage.

12. A control system for colour lighting, according to claim 11, wherein three of the light sources provide dark hues of colour and the other provides a much paler hue, said source of paler colour being the one selected by the third switching means, and the operating means being arranged to vary the voltage of said intensity-varying devices cyclically with movements of the said switching means.

13. The combination defined by claim 12 characterised in that one of said intensity-varying devices effects a variation through a plurality of cycles during the period in which the other device effects a variation through one cycle.

14. In a control system for colour lighting according to claim 1, 5 or 6, three electrical sources of light of dark hues of colour, an electrical source of light of paler hue, a source of variable voltage, switching means to select in sequence each of said sources of light of dark hues and to apply to the selected source a voltage from said voltage source which may be varied through a given range of values during the time in which said voltage source is connected to the selected source of light, a second switching means to select in sequence each of said sources of light of dark hues, the selected source differing in colour from that selected by the first switching means and to apply thereto a constant voltage equal to the maximum voltage of the first mentioned source of variable voltage, said constant voltage being applied to said second source of light throughout the time in which the voltage from the first mentioned source of variable voltage is changing in value from its minimum to its maximum value, said first and second switching means being so arranged as to interchange the said selected sources of light at the point of maximum value of said variable voltage thereby applying the constant voltage to the first mentioned source of colour and applying the voltage from said variable source to the said second mentioned source of colour.

15. The combination defined by claim 14 further characterised by the inclusion of a second voltage varying means, and a third switching means to connect said second voltage varying means to said source of light of paler hue and to maintain such connection throughout the period in which said first and second selected sources of light are connected to their switching means.

16. The combination defined by claim 15, wherein the rates of variation effected by the voltage of said voltage-varying means differ from each other.

17. A control system for colour lighting according to claim 1, having a plurality of sources of light each differing in colour from the others, and two light intensity-varying means, wherein second switching means maintains constant the intensity of the light emitted by its selected light source, and having a third switching means to connect the second of said intensity-varying means to a third light source, the light from the several sources being blended, said second intensity-varying means being designed to produce two ranges of intensity variation, there being a plurality of pre-set switches to select the range of variation to be applied by said third switching means to the third light source, operating means common to said switching means and said light intensity-varying means to operate simultaneously all of said means, and indicating means to show the hue resulting from the blending of the colours thus selected.

18. The combination defined by claim 17 further characterised in that the rate

of variation effected by one of the said light intensity-varying means differs from that effected by the other.

19. The combination defined by claim 17 or 18, wherein the light intensity is varied by voltage variation and wherein the voltage curve of the first mentioned voltage-varying means is flat-topped throughout a portion of its cycle.

20. The combination defined by claim 19 further characterised in that the voltage curves of both voltage-varying means are out of phase.

21. In apparatus according to any preceding claim for controlling a colour lighting system, a rotatable shaft having thereon a pinion and a crank, a second rotatable shaft having thereon a gear meshed with said pinion, selecting switches each having conductive segments and a brush-arm, said brush-arm being fastened to said second shaft and rotatable thereby, two voltage-varying devices each having a movable contact member thereon, driving means to effect the simultaneous movement of said contact members, one of said driving means being movably connected to said crank and to one of said voltage-varying devices, the other driving means being movably connected to said gear and to the other of said voltage-varying devices.

22. In apparatus according to claim 21, a driving shaft and a driven shaft, both rotatable, means connecting said shafts to effect the rotation of the driven shaft, the ratio of the coupling being such that the driven shaft will revolve once during a plurality of revolutions of the driving shaft, all of said brush-arms being fastened to the driven shaft, and means connected to each of said shafts to vary the voltage of one of said voltage-varying devices.

23. The combination defined by claim 22 further characterised by the addition of indicating means to denote the hue resulting from the blending of the colours selected.

24. In apparatus according to claim 22 wherein the cyclic variation of voltage of one varying device is related to that of the other device.

25. Control apparatus according to claim 1, wherein the rate of intensity variation associated with one switching means is different from and preferably a multiple of that associated with the other.

26. Control apparatus according to claim 25 in which the switching means and the intensity variation means are actuated from a common control.

27. Control apparatus according to either of claims 25 or 26 having in addition to said switching means independent means for selectively rendering different combinations of light sources available for selection.

28. Colour lighting control apparatus according to any of the preceding claims having a scale and an indicator movable relatively thereto, a unitary control for actuating the light varying means and said control functioning also to move the indicator relative to said scale, the arrangement being such that when the indicator is moved to any predetermined colour on the scale the said selecting means actuates the light sources to ensure that the said colour is emitted.

29. Control apparatus for a colour lighting system substantially as described herein and illustrated in the accompanying drawings.

Dated this 15th day of August, 1950.

ERIC POTTER AND CLARKSON,
Chartered Patent Agents,

PROVISIONAL SPECIFICATION
No. 21305, A.D. 1949.

Improvements in Colour Lighting and Control Apparatus therefor

I, ROLLO GILLESPIE WILLIAMS, a British Subject, of 35, Bellingham Lane, Great Neck, Long Island, New York, United States of America, do hereby declare the nature of this invention to be as follows:—

This invention relates to colour lighting and has amongst its objects to provide new or improved control apparatus therefor.

In carrying the invention into effect there may be a plurality of independent sources of light adapted to emit light of contrasting hue or colour; or there may be a single light source and means associated therewith for obtaining different colours; there may be means whereby a single beam emits different colours or a single light source may be adapted to emit a plurality of beams. The source or sources of light may be coloured or may have associated therewith means such as colour filters for producing the desired colour. The different coloured lights are mixed to produce the desired colour or hue. Means are provided for varying the intensity of light from the sources as desired; the light sources are preferably

of any suitable electric type and means are preferably provided for selectively varying the electrical input to the sources to vary the intensity of emitted light but any other suitable means for obtaining this result may be employed. The expression "plurality of light sources" as used herein means and includes (where the context so permits) a single light source having associated with it means for emitting a plurality of different colours, the said means constituting the "plurality of light sources".

The control apparatus according to this invention may have associated with it an indicator scale bearing the names of a range of colour, hues and associated with said scale is a manually operable indicator; it is a feature of the invention that as the indicator is moved relatively to the scale the hue or colour indicated by the indicator is automatically obtained from the light sources.

In the alternative the indicator is dispensed with and a predetermined cyclical variation of colour hues is obtained; different cyclic variation may be obtained as desired.

From one aspect the invention may be said to reside in the provision of control apparatus for a colour lighting system having at least two selecting means for selectively bringing the light sources into operation there being associated with each of said means further means for varying the intensity of emitted light the rate of intensity variation associated with one selecting means being different from and preferably a multiple of that associated with the other. In addition to the said two selecting means it is preferred that there shall be additional selecting means for selectively bringing the sources into operation and no light intensify variation means are associated with said additional means. It is preferred that all of the selecting means and the variation intensity means shall be actuated from a common control so that the light emitted at any position of the control is predetermined; it is also preferred that the indicator associated with the indicator scale shall be operated from the same control so that the emitted light corresponds with the light indicated by the indicator on the scale.

According to a subsidiary feature of the invention either or both of said selecting means may function to bring selectively into operation individual sources of light or a combination of two or more of said sources; for example at certain stages either or both selecting means may bring into operation individual sources of light and at other stages may bring into operation two or more of said sources; when one selecting means brings into operation a single source the other means may bring into operation a plurality of said sources.

From another aspect the invention may be said to reside in a colour lighting system having means for selectively rendering predetermined of the light sources available for operation in combination with means for varying the light emitted from selected of the sources so made available. In other words a plurality of different ranges of hues are available for selection in combination with means for selectively obtaining the desired hue in the selected range. If the control apparatus is provided with a scale as outlined above selected of the ranges are marked on the scale and a separate control is provided for selecting the desired range; the range having been first selected the desired colour in that range is now obtained by moving the indicator to the colour shown in the selected range.

By the present invention means are provided whereby the light smoothly merges without a break from any selected colour in one range to any selected colour in another range; furthermore any selected colour may be smoothly dimmed to nil. The invention also provides means whereby a number of selected colours can be obtained at a lighting intensity less than the colour brightness.

In order that the nature of the invention may be more readily understood, reference will now be made to the accompanying drawings in which:—

Figure 1 is a perspective view illustrating by way of example one type of control apparatus in accordance with this invention.

Figure 2 is an enlarged view of the scale shown in Figure 1.

Figure 3 is an enlarged view of the range control shown in Figure 1.

Figure 4 is a sectional elevational view of the apparatus shown in Figure 1, the section being taken on line 4—4.

Figure 5 is a sectional view on 5—5 Figure 4.

Figure 6 is a sectional detail view on line 6—6 Figure 5.

Figure 7 is a section on line 7—7 Figure 6.

Figures 8 and 9 are detail views.

Figure 10 is a circuit diagram.

Figure 11 is to be read in conjunction with Figure 10 and indicates the electrical input variation for each colour range.

Figure 12 indicates the voltage of the dimmers for various positions of the selector switch of Figure 10.

For the sake of convenience it will be assumed that the colour lighting system to be controlled by the particular embodiment of the invention now to be described by way of example, has four light sources, namely, white, red, green and blue light and these sources are so arranged and designed that the coloured lights emitted therefrom mix or mingle to produce different hues or colours as desired. It will be appreciated, however, that the number and colour of the light sources may be varied as desired. Furthermore in the particular embodiment to be described, the light sources are electric light sources of any suitable type with which may be associated reflectors, colour mediums, etc., all in accordance with known practice. For the purpose of illustration it will be assumed that the control apparatus is connected to A.C. mains.

It will be seen from Figure 1 that the control apparatus according to this invention comprises a neat box-like structure having on one face a scale 38 with indicating pointer 37 and two manually operable control knobs 1 and 14, both being mounted for rotation. Control knob 1 is associated with the range switch D and control knob 14 is associated with the selector switch C.

The range switch D is a separate unit and is connected only electrically with the remainder of the mechanisms. This switch is operated by control knob 1 mounted on shaft 2. This shaft carries brush-arms which move over contacts. In the example shown in the drawings, the four sets of brushes and contacts are shown in the form of four separate brush-arms mounted on shaft 2. These brush-arms are mounted on the shaft so as to be in line with each other and the contact brushes move over contacts mounted on a plate adjacent to each brush-arm. These four brush-arms are shown diagrammatically in Figure 10 as 3, 4, 5, 6. In the example shown, the range switch has seven operative positions. These are indicated in Figure 3 and Figure 10 as 7, 8, 9, 10, 11, 12, 13. The relationship of the four brushes, 3 to 6, to the contacts is indicated in Figure 10. For example, when the range switch is in the "Off" position (7) none of the four brushes makes any contact. When the range switch is put to "Dim" (8) only brush No. 6 makes contact. When the range switch is put to "Deep Colour Range", then brushes 4, 5 and 6 make contact, etc. For the purpose of illustration the construction of one of the brush-arms 4, is illustrated in Figure 9 from which it will be shown that the brush is in contact with the collector ring 79 and then according to its location, either in no contact with anything or in contact with 65, 66, 67, 68 or 76, 77, 78.

The range switch is, therefore, a selector switch which is moved at will by the operator and is not mechanically connected to the remainder of the control mechanism.

The remainder of the control mechanism is all actuated by movement of the knob or wheel 14 mounted on shaft 15. This shaft carries at the end nearst to knob 14 a small pinion 16, and at its far end the shaft 15 carries a crank-wheel 17. The pinion 16 engages with a larger gear-wheel 18, mounted on shaft 19 which is the actuating shaft of the rotary selector switch C. Gear wheel 18 has a crank-pin 20 mounted on its outer face and by means of arm 21, imparts a rotary motion to the controller wheel 22 of dimmer B. In the example of construction shown, the method of imparting this motion is shown in Figures 6 and 7 from which it will be seen that arm 21 rests in a groove on the outside of wheel 22 and, by means of a wire cable 23, secured at 24, and passed round the outside of wheel 22 (where it is secured at point 25) and then finally secured again to arm 21 at point 26. It will be readily seen that when the arm 21 is pulled and pushed, it will impart a rotary motion to the wheel 22 which is mounted on shaft 27 of dimmer B.

Both dimmer A and B are, in this example, shown of a type having rotary action with a total movement of 320°. At 0°, each dimmer provides full light, and at 320°, the voltage is, to all practical purposes, out.

Dimmer A is rotated in the same manner as dimmer B by means of arm 28, moving over wheel 29, and connected by means of crank-pin 30 to the crank-wheel 17.

It will be noticed that a reciprocating motion is imparted to each dimmer inasmuch as one revolution of crank-pin 30 will cause dimmer shaft 31 of dimmer A to be rotated first in one direction and then in the other. In practice, the exact amount of movement imparted to the dimmers can be adjusted by mounting the crank in a radial slot and determining the effective distance of the crank-pin from the centre of the crank-wheel. If this radius is shortened, the amount of thrust and pull given to the dimmer shaft will be also shortened, and *vice versa*.

From the foregoing it will be seen that if knob 14 is turned then by means of pinion 16, movement will be imparted to the centre shaft of selector switch C by

means of gear-wheel 18 and at the same time motion will be imparted to dimmer B by means of arm 21. Motion will also be imparted to dimmer A by means of arm 28, connected to crank-wheel 17, at the other end of shaft 15. By means of a pulley, not shown, movement of shaft 15 will also cause cable 32 to move in conjunction with the turning of shaft 15. This cable 32 passes over guide pulleys 33, 34, 35 and 36, and between pulleys 34 and 35 it is attached to indicator needle 37 which moves over the colour scale 38. Thus, movement of knob 14 simultaneously imparts motion to the indicator needle 37, dimmer A, dimmer B and rotary selector switch C.

In example under consideration, the gear ratio of gears 18 and 16 is 4:1. Inasmuch as dimmer A is actuated from a crank-wheel mounted directly on shaft 15, it will operate four times as often as dimmer B. Inasmuch as each complete revolution of shaft 15 will cause the dimmer to be turned fully up and down, the voltage curve of the circuit controlled by dimmer A may be graphed as shown at the bottom of Figure 10, from which it will be seen that the voltage in question rises and falls four times compared to one rise and fall of the voltage in the circuit controlled by dimmer B. The actuation of the mechanism in this example is limited to four complete turns of knob 14 and indicator needle 37 will then move across the full extent of the indicator scale 38.

In the example under consideration, the selector switch C is shown as having three separate brush-arms 39, 40, 41 with brushes moving over three separate plates 80, 81, 82 carrying contacts. These brushes are shown diagrammatically in Figure 10 and alongside each brush is shown the arrangement of contacts over which each brush moves. The physical construction of the contact plates is indicated in Figure 8 in which is shown front elevation of brush-arm 39 together with contacts 56, 57, 58, 59, 60, over which the brush moves. Electricity is supplied to the brush in question by means of contact ring 64. Brush-arms 40 and 41 are arranged in a similar manner, except that the contact switches will be differently arranged as indicated in Figure 10.

In example under consideration, dimmers A and B are assumed to be of the auto-transformer type which means that each dimmer is electrically connected across the electric mains while its brush-arm makes contact with the transformer winding in such a manner that by varying the position of the dimmer brush-arm there is a variation in the voltage which flows to this brush-arm.

The electrical connections for complete control mechanism are shown in Figure 10. It is to be assumed that brush-arms 39, 40 and 41 in the selector switch C move simultaneously across the contacts with which they are associated at the same time as the voltage provided by dimmers A and B rises and falls as indicated in the diagrams underneath the wiring diagram in Figure 10.

When the indicator needle 37 is in position 120 on the indicator scale, brush-arms 39, 40 and 41 are in position 1 (Figure 10) when the voltage from dimmer A will be nil and the voltage from dimmer B will be at full volts. If knob 14 is rotated, brush-arms 39, 40 and 41 will move across their respective contacts and at position 2, for example, (Figure 10) the voltage from dimmer A will be at full volts while the voltage from dimmer B will now be less than full volts. If knob 14 continues to rotate, brush-arms 39, 40 and 41 will, in due course, reach position 5 at which point the voltage from both dimmer A and dimmer B will be nil. If knob 14 continues to be rotated, brush-arms 39, 40 and 41 will ultimately reach position 9 (Figure 10) at which point the indicator needle 37 will be in position O at the extreme rght of indicator scale 38 and at this point dimmer A will be providing no voltage while dimmer B will get full volts.

From a lighting point of view, the value of the fixed relationship between dimmers A and B and selector switch C, will be varied according to the position of range swith D. For example, if range switch D is put in position 10, to correspond to " Pastel Colours Range ", then the colours indicated on the top part of the indicator scale 38 will correspond to the compound colour hue actually provided by the lighting circuits white, red, green and blue controlled by this lighting control mechanism. This will be more readily understood by the following description.

If knob 14 is turned so that indicator needle 37 is at the extreme left of the scale 38, it is seen that on the top scale " Warm White " is marked. Looking at Figure 10, it will be seen that at position 1 contact brush 40 contacts 42 which is connected to contact 65 and thence to brush 4 (which simultaneously bridges contacts 65, 66, 67, 68) and thence to the red lighting circuit. At the same time brush 39 contacts 56 which is electrically connected to 71 and thence to brush 5 which is connected with the green lighting circuit. Brush-arm 41 contacts 61,

which is electrically connected to 73, which is in contact with brush 3, which in turn is connected with the white lighting circuit. The red lighting circuit is, therefore, in series with dimmer A but at position 1 (Figure 10) dimmer A is at no-voltage. So the red lighting circuit does not provide illumination. The green lighting, however, is in series with brush-arm 39 which is fed directly from the mains, and the green light is, therefore, at full brightness. The white lighting circuit is also in series with brush 41, which is connected to dimmer B and it will be seen that at position 1 dimmer B is at full-voltage.

Summarizing, we have the white and green lighting circuits at full strength and the red and blue circuits providing no light. If knob 14 is now rotated so that the indicator needle is moved to position 110 on the colour scale, the brush-arms 41, 39 and 40, together with dimmers A and B, will have reached a position which is short of position 2 in Figure 10. At this point the red lighting circuit connected to dimmer A will be nearing full-voltage; the green lighting circuit connected to brush 39 will continue at full strength, and the white lighting circuit connected to brush 41 will be at a somewhat reduced lighting intensity due to the downward motion of dimmer B.

If the indicator needle 37 is now moved to position 105 on the scale, then brushes 41, 39 and 40, together with dimmers A and B, will be at position 2 in Figure 10 At this point brush-arm 40 is in contact with a dead stud 50, and the red lighting circuit is not in series with dimmer A. However, brush 39 is now in contact with both 56, and 57 and 57 is connected to contact 67 which is in contact with brush-arm 4 which feeds the red lighting circuit. Both red and green circuits are, therefore, directly connected to the mains by means of brush-arm 39. The white lighting continues to be connected to dimmer B but at a lower lighting intensity. It will be noticed that when brush-arm 40 is about to move out of contact with 42 and into contact with dead stud 50, that the dimmer is providing full-voltage. Before 40 breaks contact with 42, brush-arm 39, while still in contact with 56, has made contact with 57. 57 is now connected to brush 4 at the same time as 42 is connected, so in effect the red circuit is transferred from full-voltage by the dimmer (at 42) to full-voltage direct from the mains (at 57). There will be no visible change in the brightness of the red lighting circuit to the eye if 57 is contacted by brush 39 before brush 40 breaks contact with 42. At position 2 in Figure 10, we therefore have the red and green lighting circuits at full brightness and the white lighting circuit at a reduced brightness.

If knob 14 continues to be turned until the indicator needle 37 is at position 90 on the scale 38, then the brush-arms and dimmers are at position 3 in Figure 10. At this point the voltage from dimmer A is at no-volts and brush-arm 40 is on dead stud 51, having broken contact with 43 at the bottom of the voltage cycle. If the indicator needle is placed at position 85, then brushes 41, 39 and 40 will be a little to the right of position 3 in Figure 10 and at this point dimmer A, while tending to increase in voltage, will be connected via 44 to 74 which is in contact with brush 6 in series with the blue lighting circuit. If the indicator needle 37 is moved toward position 75 on the scale, brush-arms 41, 39 and 40 move toward position 4 in Figure 10, which means that the blue circuit is now connected to dimmer A, which is increasing in voltage, while the white circuit continues to be connected to dimmer B, which is decreasing in voltage. The green circuit continues to be connected directly to the mains by means of brush 39 and contact 57.

To avoid a long and complicated description of the whole cycle, Figure 11 has been included which indicates the voltages of the four lighting circuits—white, red, green and blue—at positions corresponding to 1—9 in Figure 10. The left hand column in Figure 11 indicates the seven positions of the range switch and the diagrams on the right indicate the voltage values of the four lighting circuits.

One example of interpretation of Figure 11 is as follows:—

If knob 14 is turned so that indicator pointer 37 is placed at 97.5 on the indicator scale 38, then contact arms, 41, 39 and 40 together with dimmers A and B, will be at the position shown by the vertical dotted line X1 and X2 in Figure 11. If the range switch is then turned to each of its seven positions, then the resultant colour hue provided by the lighting circuits will be as shown below.

Range Switch	Final Colour of Light
Off	No light
Dim	No light
Deep colour range	Orange
Pastel colour range	Gold
Low intensity range	Dull yellow
Low intensity dim	Dull yellow
White only	Low brightness white

From the foregoing it will be seen that the required colours can be obtained by the employment of two dimmers whereas with known colour lighting control apparatus a dimmer with associated mechanism is required for each light source; hence by the present invention costs are reduced and bulk decreased. Furthermore in known types of apparatus it is customary first to actuate a member to select a desired colour and then to actuate another member to obtain that colour; by the present invention in any predetermined range of colours the desired colour is immediately obtained by moving the selector to the desired location.

A particular feature of the invention is the layout of the colour scale as illustrated in the drawings. It will be appreciated that the provision of a plurality of scales of different "types" or ranges of colour is of considerable advantage; any of the ranges can be selected at will and it is possible by the invention to merge from any colour in one range to any colour in another range without a break in the lighting. It will be appreciated that all the ranges terminate in the same colour (preferably but not necessarily blue) at the same point in the scale (point 60). The method of merging from one colour in one range to a colour in another range consists in bringing the indicator needle to point 60, then turning the range switch D to the desired new range and then moving the indicator to the desired colour shown in that range. Any colour can be dimmed out by first moving the indicator from the colour in question to point 60, then moving the range switch to "Dim" position and then moving the indicator to either end of the diamond in the centre of the scale; at each end the blue light is reduced to no light.

When one wishes to start with no light at all and then brighten up into some colour, one commences by placing the indicator needle at either point of the diamond shape—with the range switch at "Dim"—then moving the indicator needle to blue at position 60, then moving the range switch to the desired position afterwards moving the indicator needle to the required colour.

In order to provide a complete range of low brightness colours the range switch is operated as required between "Low Intensity Range" and "Low Intensity Dim".

The arrangement of colour hues on the lower scale in Figure 2 is also designed to enable an operator to get from one colour hue to any other hue by a fairly direct route and without the need of having to pass round a complete colour circle in order to get the change. Inasmuch as this new controller is not a pre-set machine and the lighting actually changes when the needle is moved, one will have to pass through the colours shown as coming between any two selected hues. However, this colour scale is designed in such a manner that in most cases one passes in a fairly direct manner from colour to colour.

The mechanism as shown in Figures 6 and 7 for imparting a reciprocal motion to a dimmer, is an improvement on the usual "Sine" movement. It will be seen that the crank-arm 21 not only thrusts or pulls; but also changes its angle of contact with the top of wheel 22 in the course of its motion. This double movement tends to correct the flat portions of the "Sine" curve and gives more movement to the dimmer when the crank-pin is around 3 o'clock and 9 o'clock.

If the apparatus is connected to a direct current source of electricity the auto-transformer dimmers referred to herein are replaced by dimmer resistors and the wiring circuit is slightly altered as will be obvious to anyone skilled in the art.

Dated this 15th day of August, 1949.
ERIC POTTER AND CLARKSON.
Chartered Patent Agents.

PROVISIONAL SPECIFICATION
No. 2875, A.D. 1950.

Improvements in Colour Lighting and Control Apparatus therefor

I, ROLLO GILLESPIE WILLIAMS, a British Subject, of 35, Bellingham Lane, Great Neck, Long Island, New York, New York, United States of America, do hereby declare this invention to be described in the following statement:—

This invention is for an improvement in or modification of the invention forming the subject matter of co-pending Application No. 21305/49 and has amongst its objects to provide means whereby the desired colour or hue can be obtained by actuation of a control member in either of two opposite directions at will. Another object is to provide improved means for automatic operation of the control mechanism.

A still further object is to provide means whereby under automatic control any desired hue or colour can be main-

tained for a predetermined period of time.

With this and other objects in view the invention consists in the provision of colour control apparatus in which the light from two independent illumination systems are combined in combination with means for cyclically varying the intensity of the light emitted from the two systems the cyclical variation of the one system being out of phase with that of the other system.

It is preferred that at least one system shall comprise a plurality of light sources of contrasting colour or hue in combination with means whereby coincident with the cyclical variation of intensity of light emitted from that system the hue or colour of the emitted light shall change in accordance with a predetermined sequence. That is to say at each phase of rotation of the control apparatus both the colour or hue and intensity of emitted light are predetermined.

In a preferred arrangement the one system comprises a series of differently coloured lights and the other system comprises a source of non-coloured (white) light. Means may be provided for varying the amount of light emitted from one or both systems during each cyclic variation.

For manual operation of the control member there is preferably provided a colour chart and the control member is provided with a pointer or the like which is movable relatively to the chart to effect emission of that particular hue or colour indicated on the chart.

In a preferred method of carrying the invention into effect a unitary control member is provided which is mounted for rotation through 360 degrees in both clockwise and anti-clockwise directions at will to vary cyclically the intensity of light emitted from the two systems and the said pointer moves in unison with or consttutes said control member; it will thus be appreciated that by this means the required hue or colour to be emitted can be obtained by rotating the control either in a clockwise or an anti-clockwise direction. If, for example, a red light is being emitted and it is desired then to emit a blue light the control member can be moved from the red to the blue position either in a clockwise or anti-clockwise direction and by this means the control member can be moved through which ever is the shorter of the two arcs of movement to obtain the desired change

In addition to the said two systems there may of course be other systems (the light of which mingles with the light of the first two systems) and means for cyclically varying the intensity of light from the additional systems may be provided.

Control apparatus in accordance with this invention can be designed for automatic operation in which case the control member is preferably rotated continuously as by an electric motor and it may be rotated continuously in the same direction or the direction of rotation may be changed at intervals as desired. Furthermore means may be provided whereby the speed of rotation may be varied or the rotation may be intermittent with the result that any desired colour or hue may be transmitted for predetermined intervals of time.

A specific feature of the invention resides in the fact that the cyclical variation of intensity of emitted light from at least one system is not sinusoidal but is flat topped.

In order that the invention may be more readily understood reference will now be made to the accompanying drawings in which:—

Figure 13 is a diagrammatic view illustrating merely by way of example one embodiment of the invention;

Figure 14 illustrates also by way of example a colour scale for use in connection with manually controlled apparatus in accordance with the invention;

Figure 15 is a modification of the arrangement shown in Figure 1.

In the embodiment illustrated there are two dimmers A and Z and associated with dimmer A is a light transmission system incorporating a source of red light R a source of green light G and a source of blue light B and associated with dimmer Z is a light transmission system consisting solely of a source of white light W. It will be appreciated that any suitable source of white and coloured light may be utilised and the transmitted light from all the sources is blended or mingled to give the desired colour or hue.

Merely by way of example it may be said that the colours may be mingled or blended in the manner set out in the specification of co-pending Application No. 36761/46. The dimmers may be of any suitable or convenient type but in the particular embodiment illustrated auto-transformer dimmers are employed; ordinary resistance dimmers may of course be employed if desired.

The applied voltage to the two light systems is cyclically varied by any convenient means and if desired the means disclosed in the specification of co-pending Application 21305/49 may be employed. The cyclical variation of

the voltage from dimmer A is represented by a sinusoidal curve C1 and that from dimmer Z by the curves C2 and C3. These curves merely indicate the type of voltage variation and are not necessarily accurate; it will be appreciated that the variation of emitted light from the systems increases as the voltage is increased. It will be seen that C2 and C3 are both out of phase with C1. It will further be seen that the curve C1 is flat topped; that is to say during approximately 20% of each cycle maximum voltage is maintained without variation. This flat topped curve is achieved by making the dimmer contact brush associated with dimmer A move over a contact plate at full voltage potential during say the last 20 degrees of its upward travel.

Associated with the three sources of coloured light comprising the first system are a series of contact plates D1 D2 D3 D4 D5 D6 D7 D8 D9 D10. These are conveniently mounted in the form of arcs on suitable discs and brushes for wiping them are provided as indicated at E1 and E2. Conveniently there are two brushes and brush E1 wipes contacts D1—D6 inclusive and brush E2 wipes contacts D7—D10 inclusive. These brushes are mounted on a shaft which can be manually rotated clockwise or anti-clockwise as desired and a pointer P (Figure 14) rotates in unison with the brushes E1 and E2.

The construction of these discs, contacts and brushes may in principle be substantially as illustrated in Figures 8 and 9 of the specification of co-pending Application No. 21305/49 but for convenience the contacts are depicted in Figures 13 and 15 in the form of a linear projection so that the colour changes will be effected by moving the brushes (theoretically) linearly relatively to the contacts.

If the brushes E1 and E2 are so moved the different sources of coloured light and combinations thereof from which light will be emitted as a result of such movement are represented by the letters R, G, B, associated with the curve C1.

Associated with dimmer Z is a switch S having two contacts S1 and S2. When switch S is moved to contact S1 the applied voltage varies cyclically between maximum and minimum and the intensity of the emitted white light varies similarly as is indicated by curve C2 but when the switch S is moved to contact S2 the maximum applied voltage is reduced and the cyclical variation of the applied voltage and the intensity of the emitted white light is represented by curve C3.

From the foregoing it will be apparent that the white light controlled by dimmer Z commences to have effect in the colour mixture during the period that the colour lighting controlled by dimmer A and associated mechanism is remaining constant, that is during the flat topped phase. At the point when the white light reaches its peak and is about to diminish the light controlled by dimmer A also commences to reduce the intensity of transmitted light from the colour system RGB and it will be obvious from a consideration of the diagrammatic curves that there will be a constantly changing mixture of light the results of which are very effective.

Each dimmer preferably completes three full cyclical variations when the pointer is rotated through 360 degrees.

Referring now to Figure 14 it will be seen that there is an inner and an outer scale of light and as the pointer moves clockwise or anti-clockwise the hues or colours indicated on the outer scale are obtained when switch S is in contact with contact S2 and the inner scale of light is obtained when switch S is in contact with contact S1. As the pointer is moved around the scale the lights change as indicated and if for example the pointer is in the location indicated and switch S is in contact with contact S2 red light will be transmitted. If now it is desired to transmit magenta the pointer is moved in anti-clockwise direction but if it is desired to transmit amber then obivously the pointer would be moved in a clockwise direction. It will thus be seen that by the present invention the operator need not move the controller through the whole range of colours to effect the desired colour change.

When the switch S is in contact with contact S1 the value of white light is at full value and in this position the "flesh whites" the "warm whites" and "cold whites" indicated on the inner scale can be obtained by rotation of the pointer.

The pointer as shown in Figure 14 corresponds to the position of brushes E1, E2 making contact with the two left hand ends of contacts D1 and D7.

For the purpose of explanation it will be assumed that when the pointer is moved in a clockwise direction the brushes move in the diagrammatic drawing of Figure 13 linearly from left to right and produce the complete colour change shown in the outer sketch of Figure 14.

It will be readily appreciated that the apparatus in accordance with this invention can be used for automatic colour mixing such as by rotating the operative parts from an electric motor or other convenient source of power. The motor may rotate continuously in the same direction at a constant speed or the speed may be

varied and/or the motor may at intervals be reversed. If it is desired to transmit selected colours for predetermined intervals of time the mchanism may be intermittently rotated; for example ratchet and pawl mechanism may be employed or some of the teeth on the pinion of a driving member may be omitted. Consequently, although the motor may rotate continuously the operative mechanism of the control apparatus is rotated intermittently so that at intervals any desired hue or colour may be emitted for any predetermined length of time. Means for disengaging and re-engaging the motor at will may be employed and there may be a clutch between the control apparatus and the motor which may be engaged and disengaged by automatic means at predetermined intervals of time so that desired colours will be emitted during such periods.

For automatic variation the switch S is replaced by switches SS1, SS2, SS3, and Figure 15 indicates a suitable wiring diagram for the automatic operation of control apparatus in accordance with the invention. The switches S1, S2 and S3 are double-throw switches so that at three different points in the cycle of white lighting one can predetermine which or all of the three positions (corresponding to the top peak of the white dimmer curve) shall be utilised at full value of white, or whether at one-half value; thus, if double-throw switch SS1 is in the up position on the drawing, the dimmer will feed the white lighting circuit at full votlage during the period that the brush arm is in contact with associated contact strip. When the same switch is in the down position, the white circuit will be only supplied at part value during the same period of the dimmer cycle.

Referring again to Figure 14 reference is again made to the three areas on the inner scale which indicate "warm white", "cold white" and "flesh white". When the three double throw switches all cause the white dimmer Z to give full value of white, then at these areas of the dial, the light provided will be a white light of the nature indicated. When these double throw switches are in the other position, then the part value of white will cause the colour mixtures given to correspond to the range of colour hues named in the outer circle.

The embodiment illustrated is as indicated given merely by way of example and is not to be construed in a limiting sense.

Dated this 2nd day of February, 1950.
ERIC POTTER AND CLARKSON,
Chartered Patent Agents.

Leamington Spa: Printed for Her Majesty's Stationery Office, by the Courier Press.—1952.
Published at The Patent Office, 25, Southampton Buildings, London, W.C.2, from which copies may be obtained.

FIG.1.

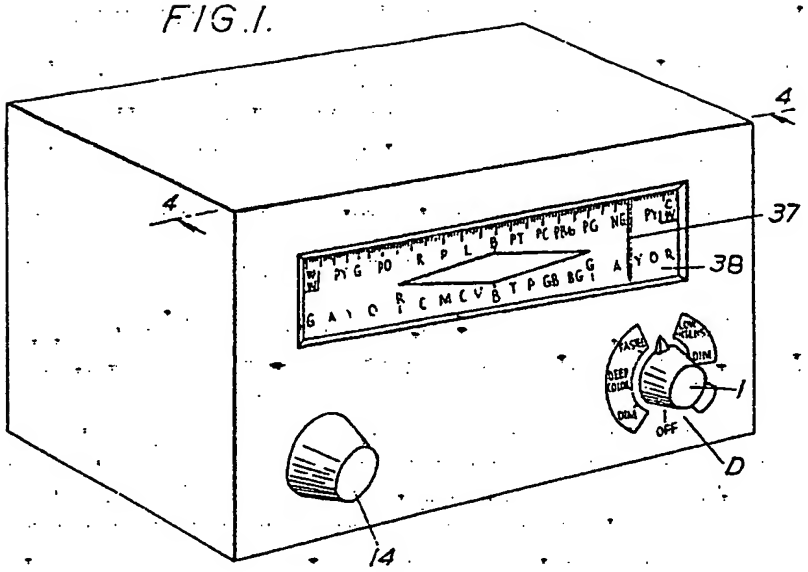


FIG.2.

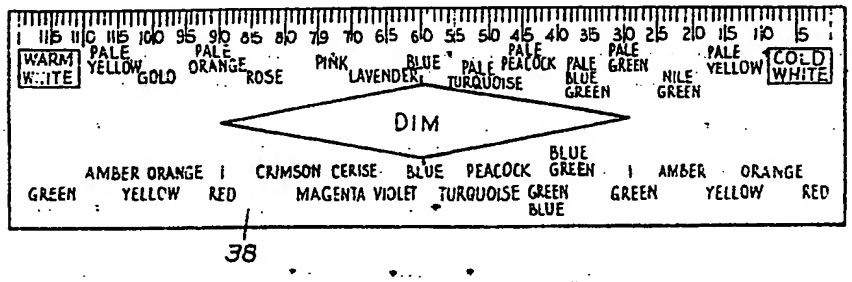


FIG.3.

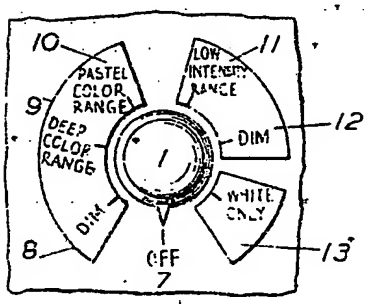


FIG.6.

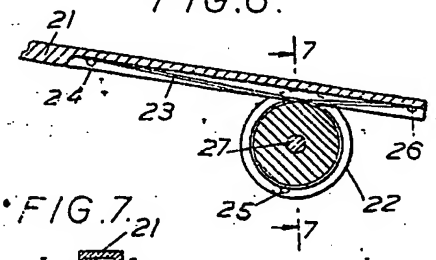
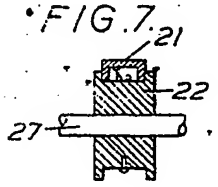


FIG.7.



685,209 PROVISIONAL SPECIFICATION No 21305 49

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale.*

SHEETS 1 & 2

FIG.4.

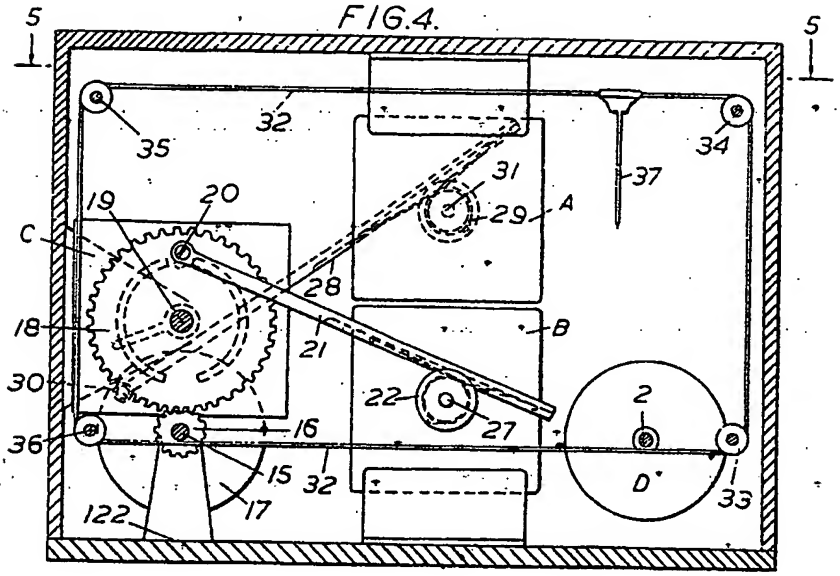
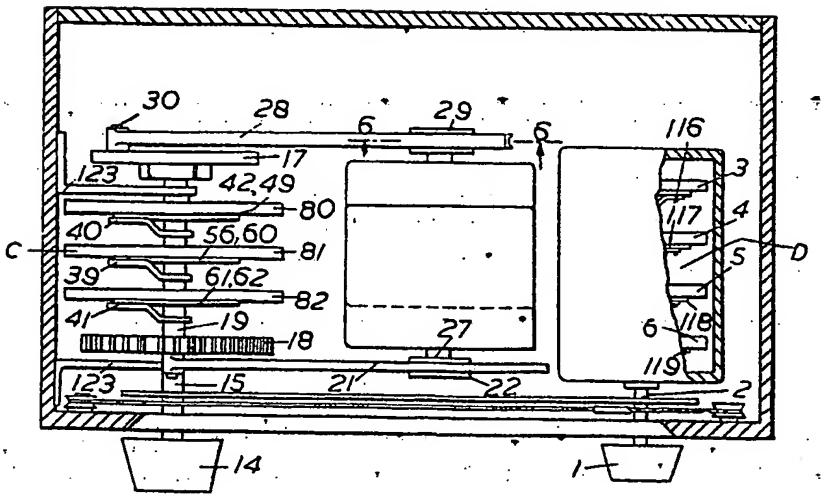


FIG.5.



685,209 PROVISIONAL SPECIFICATION N° 21305/48

3 SHEETS

This drawing is a reproduction of the Original on a reduced scale.

SHEETS. 1 & 2

FIG.1

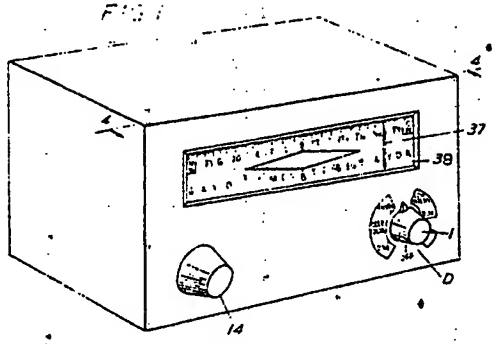


FIG.2.

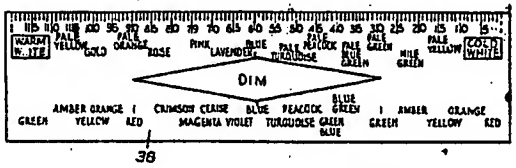


FIG.3.

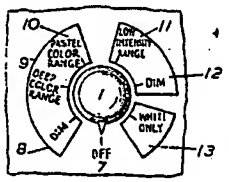


FIG.6.

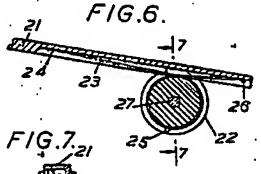


FIG.7.

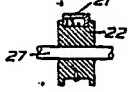


FIG.4.

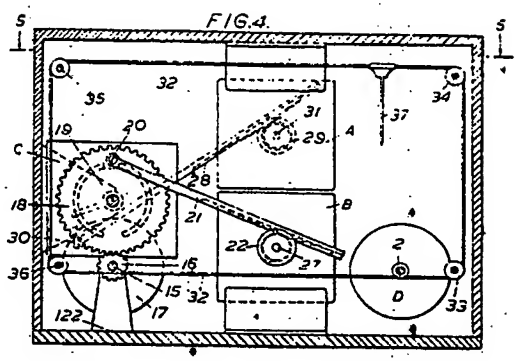
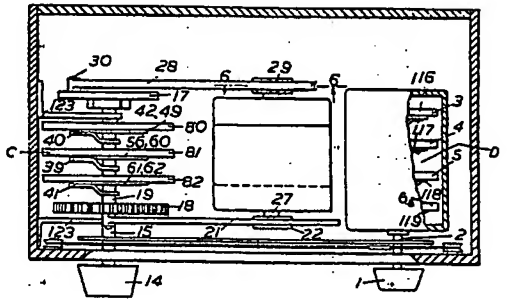


FIG.5.



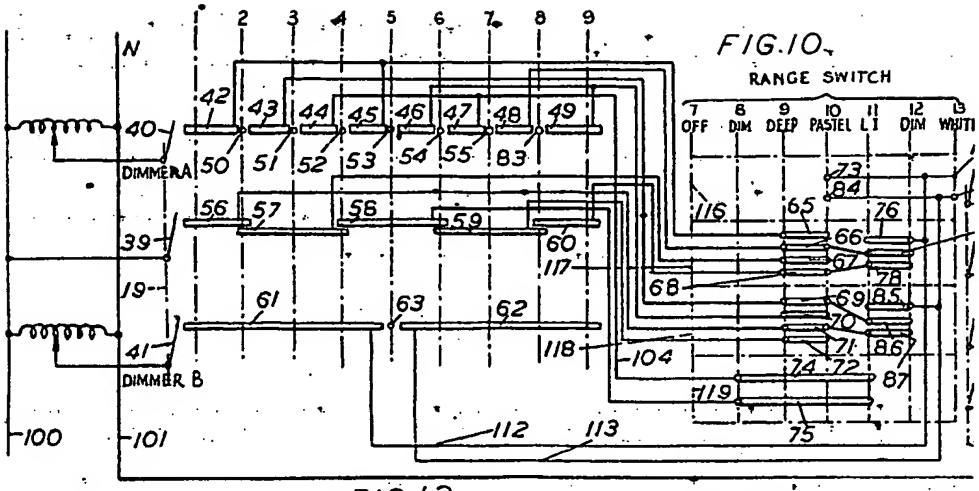


FIG.10.
RANGE SWITCH
OFF
DIM
DEEP
PASTEL
DIM
N
DIMMER A
DIMMER B
100
101
112
113
104
75

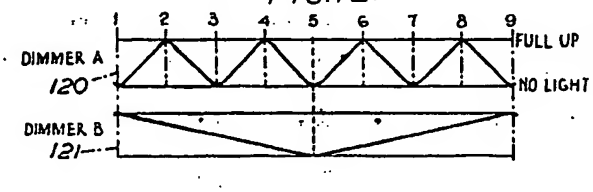


FIG.12.
DIMMER A
DIMMER B
FULL UP
NO LIGHT

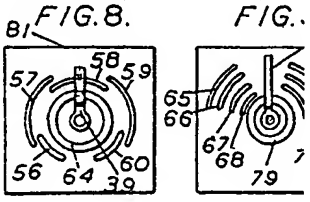


FIG.8.
FIG.

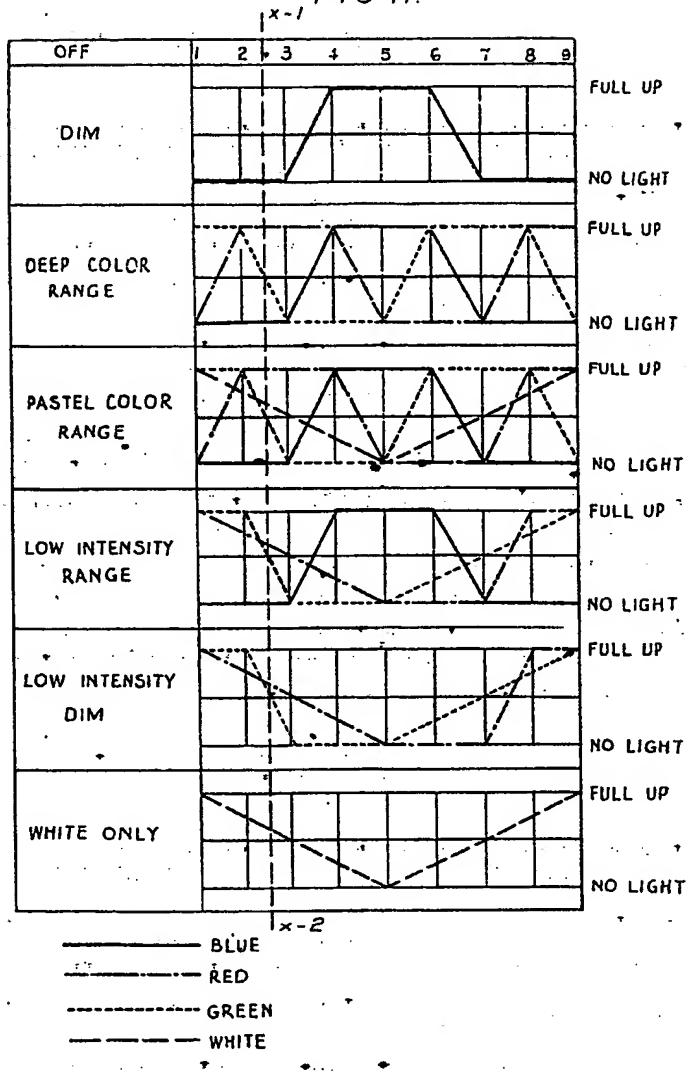
685,209 PROVISIONAL SPECIFICATION No 21305/49

3 SHEETS

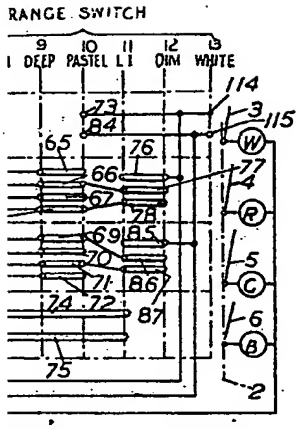
This drawing is a reproduction of the Original on a reduced scale.

SHEET 3

FIG 11.

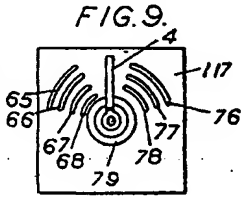


'G.10.



G.8.

FIG.9.



685,209 PROVISIONAL SPECIFICATION No 21305/49
3 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEET 3

FIG 10

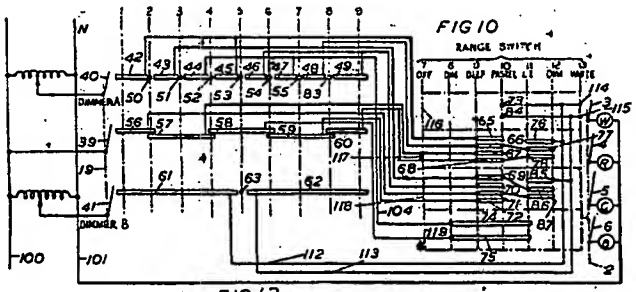


FIG. 12.

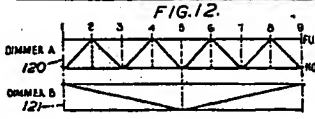


FIG. 8.

FIG. 9.

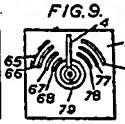
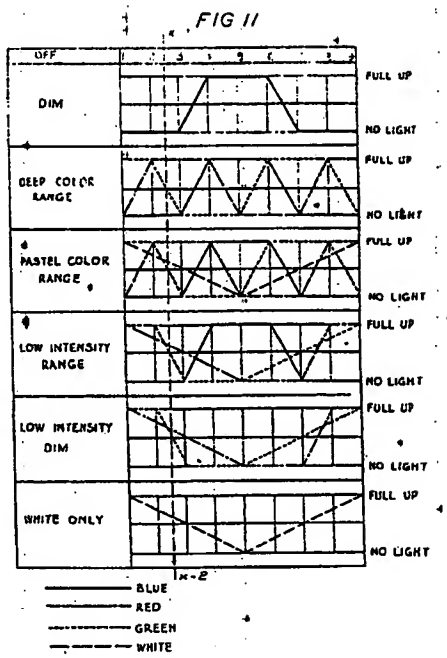


FIG 11



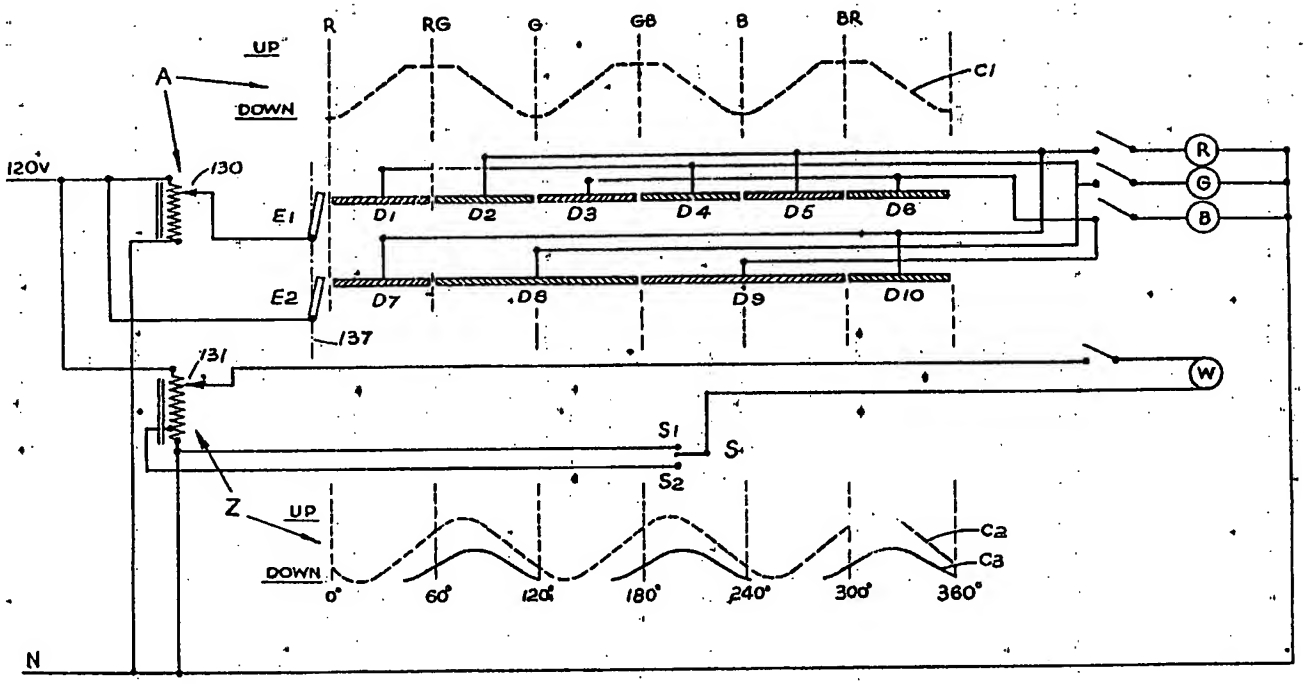

R
RG
G
GB
B
BR
C1
UP
A
DOWN
120V
130
E1
D1
D2
D3
D4
D5
D6
R
G
B
E2
D7
D8
D9
D10
137
131
W
S1
S
S2
Z
UP
DOWN
Ca
Ca
0°
60°
120°
180°
240°
300°
360°
N

FIG. 13.

685,209 PROVISIONAL SPECIFICATION No 28750

3 SHEETS

This drawing is a reproduction of the Original on a reduced scale.

SHEETS 1 & 3

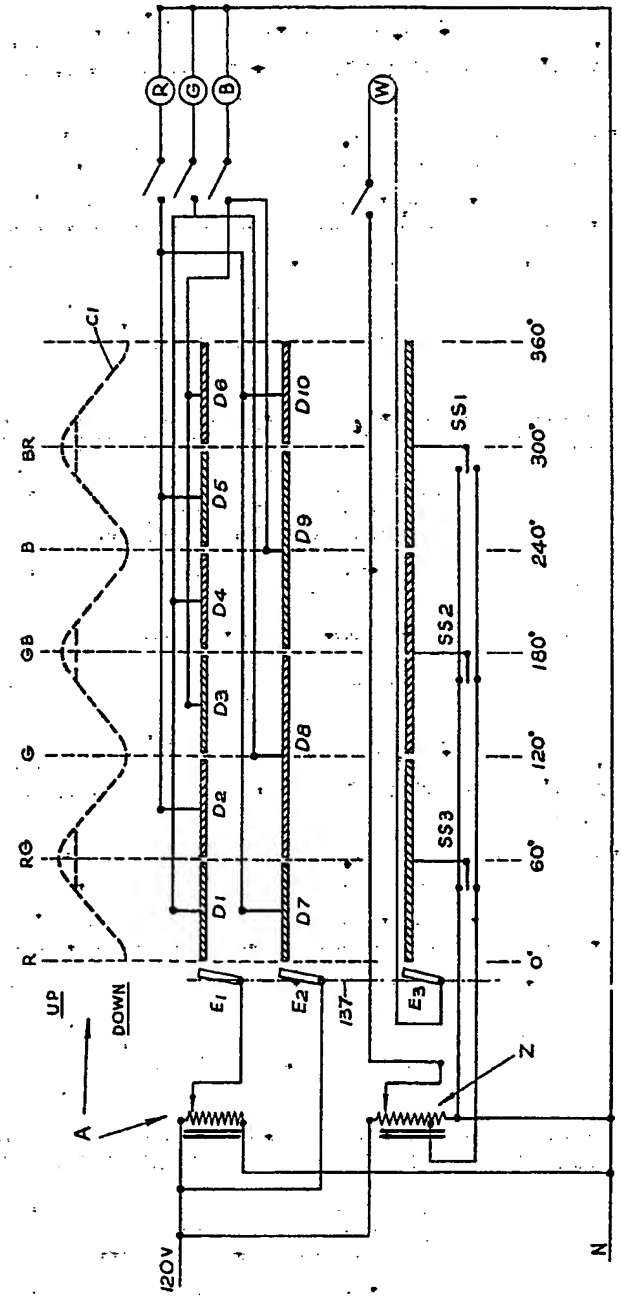


FIG. 15.

685,209 PROVISIONAL SPECIFICATION No 28715/50
3 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEETS 1 & 3

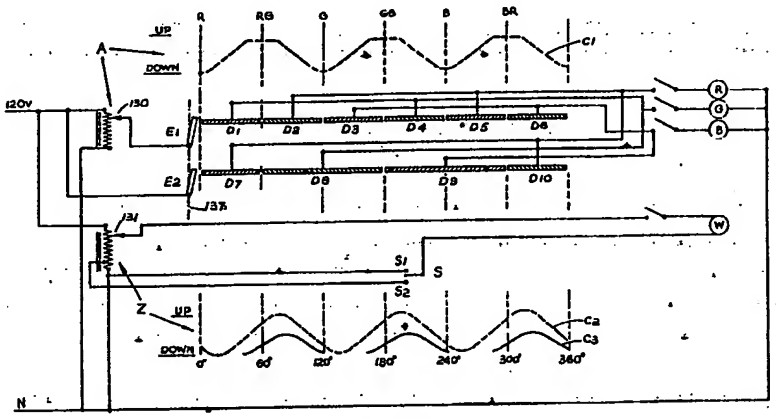


FIG. 13.

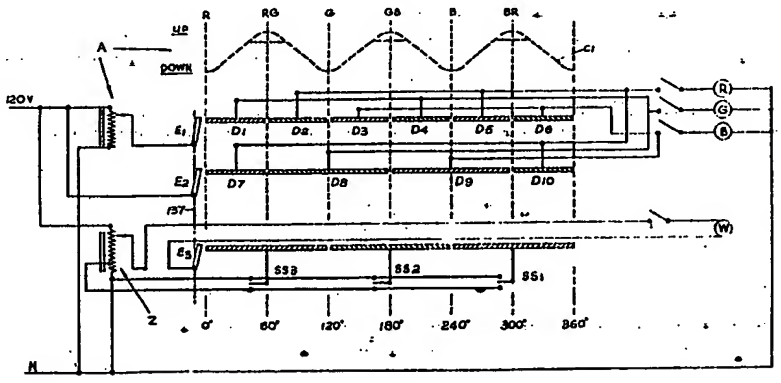


FIG 15.

685,209 PROVISIONAL SPECIFICATION Nº 2875 50
3 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEET 2

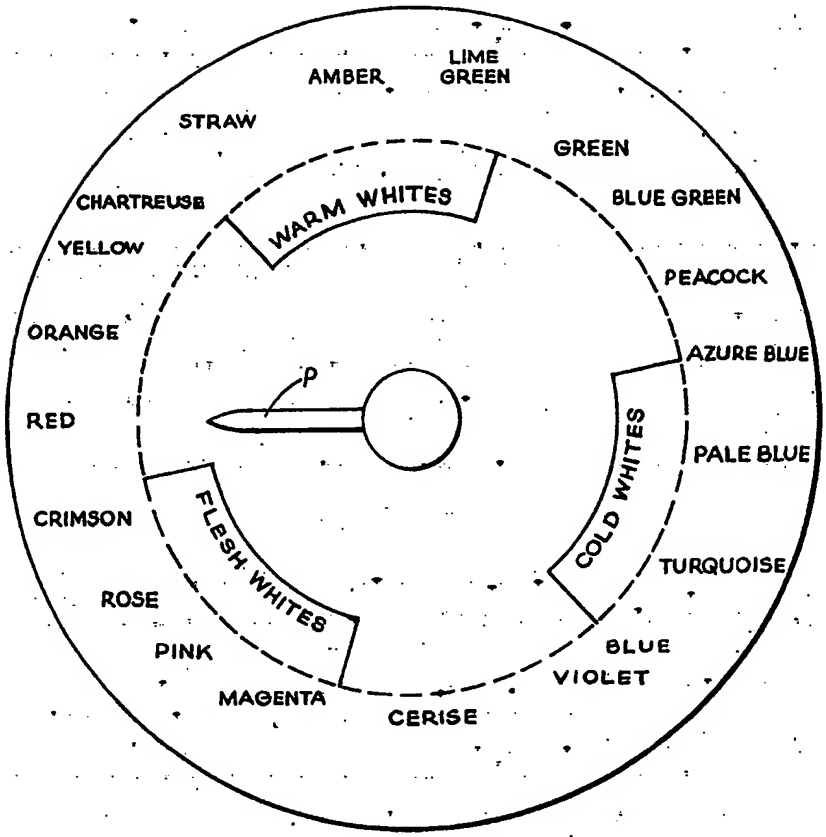


FIG. 14.